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THE ELECTRICAL TRANSMISSION OF POWER.

WE stated in our issue of the 7th that, as far as we could judge at the time, the figures given by M. Deprez would not bear a careful analysis. A closer examination of the data which have been published, however, show that the results arrived at may be, in the absence of observed figures, regarded as substantially correct, inasmuch as they agree amongst themselves. We cannot, however, too strongly condemn that most fallacious system of testing by means of a looped wire *without using earth*, and this we do in spite of the opinion of M. Tresca, who, we understand, pronounces the objections to the method to be groundless. We consider the method adopted to be inexcusable, if only from the fact that the use of earth (which would render the experiments strictly analogous to what they would be if the generator and motor were placed at two points at a geographical distance from one another), is such an exceedingly simple matter, that the non-employment of it creates suspicion. We now notice that the electromotive forces in the case of the generator and motor, are not the observed potentials at the brush terminals, but are the *internal* forces, and these must, consequently, have been calculated from the potentials referred to; why the latter have not been given in the tables, is not obvious. Under the circumstances, therefore, we can only patiently await the publication of the observed electrical and mechanical constants which M. Deprez promises at a future date. We shall then be in a position to make our own calculations, the results of which may possibly differ from those presented to the French Academy of Sciences. As to whether the transmission of 40 horse-power from Creil——to Creil will ever produce any useful results from a commercial point of view, will not be at present discussed; our main object is, when the opportunity offers, to set at rest any doubts which may exist respecting the *bona fide* character of the experiments.

West African Cables.—The secretary of the West African Telegraph Company has written to the *Standard* upon an article which appeared in that paper with respect to colonisation on the West Coast of Africa, stating, as showing the interest being awakened with regard to that part of the world, that the French Government has subsidised his company to establish a telegraph station at Conakry, on the mainland, some ten miles from the Los Islands, so that very shortly they will, by means of the company's cables, be placed within convenient telegraphic communication with Sierra Leone and Europe. This landing has probably been arranged by means of the treaty existing between the French Government and King Bala Demba.

ELECTRIC LOCOMOTION.

By A. RECKENZAUN.

III.

ABSORPTION dynamometers are seldom, if ever, applied to test steam locomotive engines; the train of loaded vehicles, running at some known speed, is generally considered the most satisfactory dynamometer; indicator diagrams are sometimes taken, and the consumption of fuel per mile run is carefully noted. If the fuel used is found excessive in comparison with similar engines tested under the same conditions of speed and load, then the fault is sought in the engine itself, or the boiler, and then remedied; the steam engine indicator gives us a faithful record of what is going on in the cylinders, it shows whether the admission and the exhaust takes place at the right time, and it gives us a measure whereby the volume of steam expended can be calculated.

On our electrically propelled vehicle we can also measure the energy expended in a given time or distance, by observing the current indicated on the ammeter, and the electromotive force shown on the voltmeter; the product of these two give the energy in watts, 736 watts being, by the latest definition, one electrical horse-power. But this result is not a *direct* measure of the energy expended in the engine which drives the dynamo at the station. On the other hand, the quantity of fuel consumed by the prime mover at the generating station does not merely depend upon the good qualities of the engine or boiler, but on the efficiency of the whole apparatus, which transforms mechanical into electrical and again electrical into mechanical energy, as well as upon the medium of transmission, be it a conductor or a secondary battery. Here we have a chain of operations composed of several links, which are:—

First link.—The prime mover, which consists of a steam engine and boiler; a waterfall and turbine, or a gas producer and gas engine.

Second link.—The dynamo or generator of electricity.

Third link.—The conductor which transmits the current from the generator to the motor on the vehicle, or the secondary battery which takes up energy from the dynamo, and then, when detached from the generator and connected to the motor, gives up its energy to the latter.

Fourth link.—The electro-motor which receives the electric energy from the conductor, or accumulator, and converts it into mechanical power.

Fifth link.—The gearing which reduces the (sometimes) excessive speed of the motor to that required by the axle of the vehicle to be propelled.

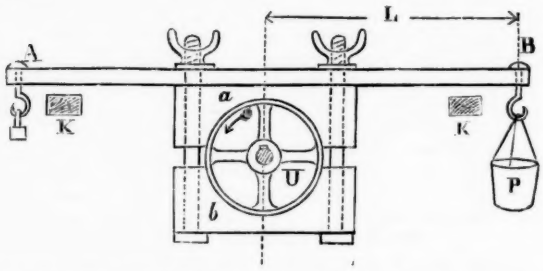
The efficiency of the whole chain depends upon the goodness of each link, but the strength of a chain is virtually the strength of the weakest link.

As promised in the last article, we will devote a few lines to the description and use of a few absorption dynamometers, brakes, or, as more recently named, "Friction Ergometers;" the latter term is the one adopted by Mr. F. J. Smith, B.A., in his useful little treatise "On Some New Forms of Work-measuring Machines," published by E. and F. N. Spon.

One of the oldest, cheapest and, in skilled hands, most reliable forms of dynamometer is the Prony brake, fig. 1. It consists of a well-balanced and turned pulley, U, provided with two wooden blocks, *a* and *b*, which encircle the rim of the pulley, and an arm, L, prolonged to A in order to balance B, when there are no weights in the basket, P. For the purpose of testing high speed machines, it is most important that the lever should be accurately balanced and the face of the pulley to be absolutely concentric and parallel with the shaft, otherwise grave errors (owing to the great speed, which multiplies irregularities a thousandfold) are introduced.

After fastening the motor securely upon a bench or platform of a convenient height, and fixing the pulley upon the projecting shaft of the armature, a continuous stream of soapy water is supplied to the brake, through a funnel not shown in the sketch. from a tank over-

head; a tap within easy reach of the brake-man is desirable, so that he may regulate the flow of water to the requirements of the brake blocks. As we are measuring the power of the motor by converting the whole of its work into heat, by means of friction, it is necessary, in order to secure uniformity of friction, that the lubrication should be constant. The pressure upon the pulley face is regulated by means of thumb nuts working in easy-fitting threads on the bolts, as shown in the



sketch. In starting the motor some dexterity must be displayed by the brake-man in speedily adjusting the pressure, because, if the blocks are too tight, there is a tendency for the brake lever to be carried round; to prevent such an accident it is well to provide stops, K, K, which will give a play of about 2 inches up or down the horizontal centre line. If, in starting, the blocks are too loose, then the pulley (with a series wound motor) will run round at a furious rate. The brake-man, therefore, should give the command for starting (turning on the switch), whilst he keeps his attention upon the thumb nuts; as soon as he finds his brake well balanced, he gives the signal for the other attendants to take the speed, current and electromotive force; it takes three persons to make the experiment with a motor of more than 1 or 2 H.P., because all the readings have to be taken simultaneously.

To ensure accuracy, it is well to extend the period of one test over half-a-minute or a minute, during which time the lever must be kept perfectly balanced; any irregularity in the brake will manifest itself on the ammeter, whose needle, if sensitive, will vibrate synchronously with the slightest variations in the coefficient of friction, or the pressure between the pulley and the wood blocks. With a given electromotive force, the speed, and the current of electricity flowing through the motor, is regulated by the weight, P, in the scale or basket; the greater this weight, the slower will the machine run, and the greater will be the current consumed; the current is a maximum when the brake is so tight that the armature cannot revolve, then the wires forming the circuit are being heated excessively.

The friction surfaces of the brake should be as large as possible, so as to dissipate the heat generated readily, otherwise the pulley gets so hot that the water will be evaporated before it can flow to every part of contact. Mr. Maw (*Engineering*) gives the following practical rule for finding the minimum dimensions of a brake pulley:

$$\frac{v\,a}{\text{H.P.}} = 700$$

where v is the velocity of the pulley face in feet per minute, and a the width of the rim in contact with the blocks; the product of these two factors divided by the horse-power to be measured, should give a quotient of not less than 700.

The horse-power absorbed by the brake is found by formula

$$\text{H.P.} = \frac{2 \times \text{L} \times 3{\cdot}1416 \times n \times \text{P}}{33000}$$

where L is the distance of the centre of suspension of the weight from the vertical centre line of the pulley, in feet; n the number of revolutions per minute, and P the weight, in pounds, at the end of the lever, L. 33,000 foot pounds per minute being one H.P. (English).

If the length of the lever, L, is taken in metres, and P in kilogrammes, then the formula stands thus

$$\text{H.P.} = \frac{2 \times \text{L} \times 3{\cdot}1416 \times n \times \text{P}}{75 \times 60}$$

75 kilogrammetres representing one H.P. per second (French).

With electro-motors n is generally very large, 500 to 2,000, according to the size of the motor, and P comparatively small, therefore the utmost care has to be exercised in balancing an ordinary Prony brake.

IS CAPACITY VARIABLE?

OF all apparatus more or less intimately associated with submarine cable engineering the condenser is the poorest in literature, asserts the *Electrical Engineer*. Our theoretic knowledge of the subject has been largely added to by Mr. Blakesley and others, but the men who have made the study of these instruments a specialty, and who have known them under every possible condition of temperature and climate, have wisely or unwisely elected to keep their experience to themselves. It is a well-known fact that of all apparatus the condenser offers the most accurate means of determining the length of a section of cable of a certain given capacity whose end is sealed or otherwise insulated. In a broken continuity fault it is invaluable; and in connection with the working of cables its uses are manifold. The late Mr. Hockin had a wide and extensive acquaintance with this instrument, possessing among other things some very interesting data relating to the variation in capacity presented by a series instead of a multiple arc arrangement. All this, however, is more or less foreign to the question. What we require to know is this—Is capacity, whether of a condenser proper or of a submarine telegraph cable, a fixed quantity, or is it subject to variation under different conditions of temperature and climate? We may take it for granted that the answer is opposed to any possible variation, or that it supposes the difference to be negligible, in that no coefficient for any such variation exists. We may presume, also, that a series of exhaustive tests, conducted at many different temperatures with both condensers and cables, have given no indication of the existence of any appreciable difference; but is it not a matter of possibility that constant exposure to the combined heat and humidity of a tropical climate may, after a number of years, bring about a deterioration in both instances, a deterioration which may at any particular station be general—that is to say, affecting the standard apparatus, the working condensers, and the cable? Our own experience inclines us to support this hypothesis. In the case of a cable, the *apparent* capacity may be said to vary with the insulation; for the reason that although a higher or lower absolute resistance may not argue a capacity higher or lower than the given quantity *while the cable is undergoing electrification*, it has a decided influence upon the discharge readings, and therefore allows an error to creep into the test. To make this clear we will suppose the cable to be theoretically perfect. That being so, it will retain its charge for an indefinite period, and a discharge taken at any time will give the true capacity value. If, however, the cable be imperfect there will be a loss during the interregnum between charge and observation, and the longer the interval and the lower the resistance of the dielectric the greater that loss will be. Now, the resistance of gutta percha is in the inverse ratio to temperature, and although the interval we have mentioned be made as short as possible, there will yet be a loss which will be variable with time and insulation resistance, a difference which in the case of shore ends laid in hot shallows is certainly appreciable. This is an argument based not upon theory but upon actual verification of

the fact. We remember a fault occurring in the shore end of a long cable. The deep sea section gave the correct Cp., but the shore end—some 40 knots in length—laid in shallow and tepid water, presented an abnormally low insulation resistance, and a capacity ·02 micro. per knot less than that of the other section—or a total difference of nearly three knots. With regard to condensers proper, it is not likely that expansion or contraction of the plates, due to difference of heat, would exert any disturbing influence upon the readings, or that the climacteric effect upon the insulating substance would be material. We maintain, however, that these instruments fall in value in the tropics after a certain time, and that sooner or later the cause will have to be ascertained and the remedy applied.

THE WIMSHURST INFLUENCE MACHINE.

MR. JAMES WIMSHURST gives in the current issue of the *English Mechanic* a few practical hints upon the working of the influence machine which bears his name, and these are of sufficient interest to induce us to reproduce them in our columns. Mr. Wimshurst commences by saying that no doubt many of the happy possessors of the machine will have rejoiced at the brilliant sparks and the beautiful brush discharges which they so easily obtain from the machines. But other possessors of the machine may, from the want of not understanding how best to adjust the parts, have been less fortunate in the results obtained.

The few lines which follow have been put together as the result of a somewhat lengthy experience in the treatment of the machine in question, and contain a few hints as to the more frequent causes of non-success.

Without any preliminary description of the parts of the machine, we will at once examine the points which are essential to success.

First.—How many sectors have you got upon the plates? If you have only ten sectors, you must not expect the machine to be self-exciting, unless it be in such an atmosphere as is usually found in an ordinary living room; but when excited the ten sectors upon each disc is perhaps the best arrangement for length of spark. With this number of sectors, and with good Leyden jars, the spark should leap through space equal to nearly half the diameter of the disc. With twelve sectors, the atmosphere may be a little less dry; but with sixteen or eighteen sectors upon each disc, it will be freely self-exciting under almost every condition of atmosphere; while, if say forty sectors are placed upon each disc, it is only with difficulty, and under the very worst conditions of atmosphere, that self-excitement can be prevented.

It will be said by some that there are conditions under which it is not self-exciting, and the remark is true; the reason why is that in an atmosphere saturated with moisture, everything, including the machine, is coated with a thin film of water, and as electricity of this character is free to travel through water, it is not possible to upset the normal condition of the sectors.

Again, this fatal coating of water is readily produced in a fairly dry atmosphere, by condensation, and this may readily be tried. Let us first test that everything is in proper order, by exciting a machine in a cold room, and then carry it into a nice warm room, in which a few friends are anxiously waiting to witness the results. In about half a minute we turn the handle, and what do we find? Nothing. We keep turning the handle for, perhaps, two or three minutes before the electricity shows itself, and then all goes well. The explanation of this is that the cold surfaces had condensed the little vapour upon themselves, and then, after a few minutes, when they had acquired a temperature nearly equal to the surrounding atmosphere, the condensed vapour was again taken up by the atmosphere. This experiment shows that the temperature of the machine must not be any less than the atmosphere in which it works; while to produce and to exhibit the maximum results, say, in a lecture hall, the whole of the apparatus should be kept slightly warmer than the surrounding atmosphere.

Then, again, the neutralising rods and their brushes are important; the metal brush must be in absolute metal contact with the neutralising rod, and the brushes at each end of the rod must touch the sectors on opposite sides of the centre of each plate at the same time. If the rods are not of proper shape to cause the brushes to touch the sectors in this order, bend the rod to a proper shape.

Where are the neutralising brushes placed? You cannot expect much if they are wrongly placed. Take your watch, hold it by the chain, and let its back come to the spindle on which the discs revolve; the neutralising rod for the front disc should then be parallel with a line joining XI and V o'clock, and the rod at the back of the machine, seen through the glasses, must be on a line joining I and VII o'clock—that is, the two rods will make an angle with one another of 60 degrees. The above is about the best working position; though if the machine does not seem to pick up its charge readily, the rods may be turned into a more horizontal position.

The brushes must be kept in good condition and clean. If they are worn out, or badly corroded, replace them with new ones. Nothing is easier: get the smallest quantity of fine wire, which any of the gilt-lace makers will sell, only be sure it is nice and fine; then a paper knife, or a card about 1¼ in. in breadth; take about ten turns of the wire on this, and cut the wire; now with a knife cut all of the ten turns at the one edge of the card or knife, slide the turns off, holding them firmly together, and then, with the other hand, tightly screw up the uncut end, and the brush is complete, except only that the loose ends will require to be clipped with a pair of scissors to remove the jagged ends. Pull the old brush out, and place the screwed end of the new brush into the hole at the end of the rod, and a small wooden peg squeezed in alongside the brush holds it securely in place.

The balls on the discharging rods should be unequal in size to give the best results. To obtain the maximum length of spark with, say, 17 in. discs, the one ball should be about ⅜ in. and the other about 1¼ in. diameter. They should be nicely polished. This arrangement also gives very good brush discharges. When the balls are of different sizes, attention must be given to make sure that the (−) or the (+) electricity is on that side of the machine which will give the best results. This is readily done by slightly darkening the room and noticing on which collecting comb is the brush, or which the luminous points. The difference is very marked. Having done this, then see that the larger ball is in connection with that comb which has the brushes on its points.

To reverse the current, where this is necessary, the better course is to charge a Leyden jar from, say, the right-hand comb. Then close the discharging balls, and with them closed turn the discs a few revolutions in the opposite direction; then separate the discharging balls, and touch the left-hand comb with the charged Leyden jar. The current will then be found reversed.

Leyden jar connections.—To produce the greatest length of spark the inside coating of the two jars should be connected to the combs, and the outside coatings of the two jars must be connected together—say, for instance, let the jars stand upon a strip of tinfoil; of course, the inner coating of each jar is in connection with only the one comb. Good stout smooth wire forms the best connection, and great attention must be given to make sure that there are no points left open. To leave the sharp ends of the wire exposed is very damaging to the results, for nearly all the electricity would escape from it into the atmosphere. Try this as an experiment: Put your Leyden jars in circuit, and notice the results. Then get a pin or a needle, tie it on one of the wires so that its point projects away from the wire and from the machine, then endeavour to get the results which the machine formerly gave, and you

will find the difference very marked. Next fasten a pin in similar way to the other wire or Leyden jar, and try the result; you will find almost nothing visible. It is a most useful experiment for amateurs, because it will so firmly fix in their minds the great importance of leaving no points exposed, and on the contrary, will show the value of smooth surfaces.

Dust.—Always keep your electrical machine free from dust; each atom constitutes in some degree a point, and moreover, it forms in some degree a conductor of electricity.

The foregoing points may each and all be as indicated; nevertheless, the charge will not remain in the Leyden jars. This condition is produced by a crack probably in one or more of the Leyden jars, and each one should be separately tested for insulation.

If the machine be made up with vulcanite supports for the combs, each of them should be separately tested, for sometimes the vulcanite has a brown-coloured surface left upon it, which freely conducts away the electricity.

Oil.—Never work a machine without first knowing that it has oil in all the working parts. A little sperm oil will keep liquid and last for some weeks; but when using the oil can, be careful and don't put too much oil—it messes everything.

Sparking Plates.—With forty or more sectors, and leaving the spaces between them about a $\frac{1}{4}$ inch, very pretty results may be obtained: the sparks jump from sector to sector, and show quite a shower; but for this the discharging terminals and the combs are best removed. Adding the combs and the Leyden jars, and allowing the discharges to take place from sector to sector, gives fewer, but very much brighter, sparks.

The foregoing remarks apply chiefly to the earlier forms of the machine, which were not furnished with four Leyden jars to make the supports for the combs; nevertheless, they equally apply to the newer form of machine. But to obtain the brush discharge, and for several other purposes, it will be necessary with the newer form of machine to break the circuit between the outer coatings of the Leyden jars. This is readily done by removing the wire, which is fitted between the terminals upon the base or stand.

The bosses working too loosely upon the Spindle.—When this occurs, you will probably find that a brass spindle, instead of a steel spindle, has been used. A brass spindle, with brass bushes inside, soon chafes loose the bosses. The only cure for this is to get a suitable length of steel wire, just a little larger than the old spindle, and then put it in place of the smaller brass one.

Having attended all these points, some one is pretty sure to say: There is an abundance of electricity, but it is all at the top and the bottom of the glass discs, and none at the combs. To him may be said: You have not strictly attended. Turn the handle of the machine in the opposite direction, and you will then see that electricity leaves the top and the bottom, and seats itself at the combs. The cure for this is to see that the driving band at the back of the machine is crossed, and the front band the straight one, or the neutralising rods and their brushes are wrongly placed. The lower brush to the front plate should be under the right-hand comb, and the others in relation to it, as earlier described.

The newer form of machine: some may say it does not give so long a spark or so good a brush as some other machines do; but it must always be remembered that it is designed as a compact machine of great power to give good average results of every kind.

The Nile Telegraphs.—In regard to Major-General Webber's paper on "The Telegraphs of the Nile Expedition," read at the meeting of the Telegraph Engineers and Electricians last week, and reported in another part of this journal, we may remark that the greater part of the apparatus used during the expedition was supplied by Latimer Clark, Muirhead and Company, Limited.

EARTH CURRENTS.

(An attempt to estimate the intensity of the magnetic field producing "earth" currents in telegraphlines.)

FROM frequent observations taken in 1882–83 at Belgaum, India, it was substantiated that earth currents as a general rule flowed east to west in the forenoon and west to east in the afternoon, in telegraph lines inclined to a north and south line, and best in those running mainly equatorially. In a north and south position lines were little affected. Maxima occurred between 9 and 10 a.m., and between 2 and 3 p.m. (*vide* "Earth Currents in India," *Journal Society Telegraph Engineers*, dated 16th September, 1884). Averages for March, 1883, at 9 to 10 o'clock a.m. gave a maximum apparent difference of potential between Bellary and Belgaum, 192 miles apart, of about 1·5 volts. Of course in magnetic storms it is much larger, 20 or 30 volts having been observed on the same line by the writer; and in the noted storm of November, 1883, probably much more. From the observed difference of potential it is here attempted to calculate, the intensity of the field between 9 and 10 a.m. in March, 1883, on the supposition that the field is an uniform one, and the lines of force perpendicular to the plane of the earth's orbit.

In March there will be an inclination of the telegraph line from Belgaum to Bellary, which will be taken at $23\frac{1}{2}°$, and the horizontal length will be L sin. $66\frac{1}{2}°$, and L being 192 miles this quantity will be 175·08 miles. The effective component of this line will be the perpendicular from the centre of the arc to the chord. An arc in length only 175·08 miles on the surface of the earth subtends a very small angle, only 2°·53 at the centre (taking the radius to be 3962·5 miles). The portion of the radius from the centre of the circle to the bisection of the chord will be

$$r \cos. \frac{\theta}{2} = 3962{\cdot}5 \times {\cdot}9997 = 3961{\cdot}31125.$$

Deducting this from the radius 3962·5 there results 1·18875 miles, the vertical height of the curve at its centre, or in centimetres 191165. The velocity of rotation of the earth on its axis is 0·288 mile per second for a place on the equator, or about 47,000 centimetres. Then supposing ϵ to be the electromotive force developed in the wire, L the length of the effective portion, v the velocity of rotation, θ the angle of inclination of L to the lines of force, H the intensity of the magnetic field,

$$\epsilon = \mathrm{H\ L}\ v \sin. \theta$$

then $$\epsilon = \mathrm{H} \times 191165 \times 47000 \times \sin. 90°.$$

This electromotive force is, however, but insignificant as compared with that developed in the wire by the earth's motion forward in its orbit. The velocity in this case is 18·9 miles per second, or about 3040000 centimetres. At the time in question, 9 to 10 a.m., the line will be about 45° inclined to the lines of force, and as above we shall have the effective component (L sin. $66\frac{1}{2}°$) × sin. 45°, and the formula in this case will be

$$\epsilon^1 = \mathrm{H\ L} \sin. 66\tfrac{1}{2}°\ v^1 \sin. 45°$$

then

$$\epsilon^1 = \mathrm{H} \times 27901190 \times 3040000 \times {\cdot}7071.$$

Now in the first case the motion develops an electromotive force antagonistic to that which results from the second. The latter, from the superior velocity and from the longer line opposed at right angles to the lines of force must be the greater of the two. The electromotive force actually observed between Bellary and Belgaum is therefore the difference between ϵ^1 and ϵ. Consequently we have

$$\epsilon^1 - \epsilon = \mathrm{H\ L} \sin. 66\tfrac{1}{2}°\ v^1 \sin. 45° - \mathrm{H\ L}\ v \sin. 90°$$

and the observed E.M.F. is 1·5 volts, therefore

$$1{\cdot}5 + 10^8 = \mathrm{H} \times 27901190 \times 3040000 \times \sin. 45°$$
$$- \mathrm{H} \times 191165 \times 47000 \times \sin. 90°.$$

From which results

H = ·0000025 G.C.S. units.

This, then, is the intensity of the field at that part of the earth's orbit that was passed through in March, 1883. If this field is created by the sun, the intensity in its immediate neighbourhood must be very great. We can conceive in this view, and from the above considerations, of modifications taking place by the motion of the moon, and of the other planets, so far as the earth is concerned. Diurnal variations in earth currents would of course follow both from the changes in the strength of field to which the surface of the earth is subject during a complete rotation, and also from the conflicting electromotive forces created by the rotatory and progressive motions. E. O. WALKER.

2nd November, 1885.

DYNAMO ARMATURES.

(POSTCRIPT.)

A POINT connected indirectly with the subject treated and of considerable interest may receive attention here. It has reference to the compounding for constant potential of dynamos with Pacinotti armatures.

The ratio of series to shunt wire or, more correctly, the ratio of the excitement required to be furnished by the two coils in any compound dynamo, depends upon several relations in the machine which need not be here discussed; but it is observed that, other things being equal, the addition of projecting teeth on the armature core necessitates a new adjustment of the series and shunt wire. The *ratio* above referred to must be different for the modified armature, and I have found that the excitement furnished by the series wire may remain unaltered, while that furnished by the shunt must suffer considerable reduction if the

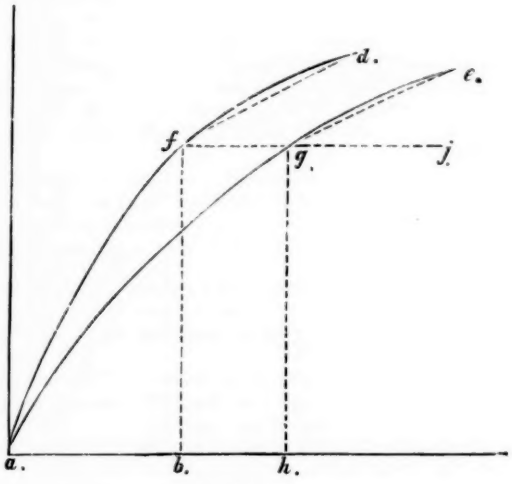


FIG. 11.

machine is to govern at the same potential and speed as formerly. In machines therefore having Pacinotti armatures, it will be found that the excitement furnished by the shunt coils is less compared with that furnished by the series coils than in machines having smooth armatures, and for the following reason:— Let the two lines, *a*, *d* and *a*, *e*, fig. 11, represent the saturation curves for the armatures with and without projections respectively, the strength of field in terms of the volts obtained for different exciting currents at a uniform speed of rotation being represented by ordinates, and the exciting currents by abscissæ. In the first instance, let the excitement furnished by the shunt coil be equal to *a*, *b*, and further, let *b*, *f* be the difference of potential at the terminals of the dynamo which is to be constant. In the second case, to give the same difference of potential, the excitement furnished by the shunt coil must be equal to *a*, *h*. The shunt excitement is therefore greater with the smooth armature. As regards the series winding, it has been shown elsewhere* that the value of the series coil in adding to the E.M.F. of the machine is proportional to tan. *d*, *f*, *g*, or tan. *e*, *g*, *j*, accordingly as we are considering the one or other of the curves. But in the example given, the tangents are similar, both curves having the same average inclination from the point where the series comes into use to the extreme limit of its action. The value of the series wire in adding to the E.M.F. of the machine is then the same in each case, and it follows, therefore, that only the shunt requires modification. This may not be the case always. It is possible that both series and shunt may require readjustment, but when the resistance of the magnetic circuit is reduced in the way described, the readjustment made must in every case result in a different *ratio* of series to shunt excitement. W. B. E.

ON MAGNETISATION PRODUCED BY THE DISCHARGES OF CONDENSERS.

By M. Ch. CLAVERIE.

IT is known, since the experiments of Savary, that if we pass the discharge of a condenser in the neighbourhood of a steel needle, this needle will be found magnetised, sometimes in one direction, sometimes in another, with a variable intensity depending upon multiple circumstances.

The explanations of the anomalies observed, proposed by Savary, and subsequently by Verdet, rests upon the hypothesis that each of the steel needles is magnetised in the same direction in its entire thickness. It seems, indeed, that with needles of the diameter of those employed by Savary ($\frac{1}{4}$ millimetre) it must be so. Most frequently it is nothing of the kind.

If we pass the discharge of a battery near a needle of tempered steel, and if we eat away this needle progressively with hydrochloric acid, determining the magnetic power at equal intervals of time, *e.g.*, every ten minutes, we generally find in the interior of the steel magnetisations alternately in opposite directions, and which have penetrated to different depths.

My experiments have been made with a battery of 12 elements of a capacity of about $\frac{1}{1000}$ microfarad. The steel needles were placed along the axis and at the centre of a magnetising coil of 300 metres in length and 13 millimetres in diameter. This spiral was made of a copper wire well insulated, and of $\frac{1}{2}$ millimetre in diameter. The field produced by a current of the intensity 1, has in the middle of this spiral an intensity $9\pi \times 1{\cdot}998$, and 0·05 metre on either side of the middle this intensity is still $9\pi \times 1{\cdot}9975$. We may, therefore, admit that a needle of 15 millimetres in length, placed in the middle of this coil, has all its points in a uniform field. The difference of potential between the two poles of the battery was regulated by the distance between the two balls of a discharging rod, fitted with a micrometric screw.

Whatever may be the distance, if all the communications are metallic, we obtain in a needle of hard tempered steel, capable of breaking against glass, superposed magnetisations, of which I will give the following example: The explosive distance being 10 millimetres, and the needle having the length of 15 millimetres and the diameter of $\frac{1}{2}$ millimetre, I have found, after successive corrosions in hydrochloric acid of 10 minutes each, the following magnetic powers, referred to an arbitrary unit:—

* Note on the Regulation of Dynamos, *Electrician*, June 5th and June 12th, 1885.

+ 20·5, + 14·5, + 5, − 5, − 11, − 15, − 18·5, − 13·5, − 16, − 13, − 9, − 6, − 3·5, − 2, + 5, + 7, + 8, + 10·5, + 12, + 11·5, + 11, + 8·5, + 6·5, + 6, + 3, + 2, + 1, − 0·5, − 0·5 + 0·5, the sign + indicating magnetisation conformable to Ampère's law.

It is known, on the other hand, since the experiments of Feddersen on the discharge of condensers, that with a sufficiently low resistance of the circuit the discharge oscillates from one pole to the other with a gradually decreasing intensity, and that it is thus if we determine the discharge through a metallic circuit. If we increase the resistance progressively by means of the intercalation of liquid columns, at a certain point the discharge, instead of oscillatory, becomes continuous.

If we pass a continuous discharge near a needle of hard tempered steel, we not only never observe any reversal in the direction of the magnetisation, which is always conformable to the law of Ampère, but the magnetisation has the same direction in all parts of the needle where it penetrates.

On interposing in the circuit of the battery a column of sulphate of copper of 112 millimetres in length and 3 millimetres in diameter, an explosive distance of 8 millimetres is sufficient to magnetise the needle up to the axis, as may be found by means of successive corrosions with hydrochloric acid. Stronger discharges, corresponding, *e.g.*, to explosive distances of 10 and 12 millimetres, give the same magnetic momentum, and the same magnetisation throughout the whole thickness. Discharges corresponding to less explosive distances give feebler momenta and a less profound magnetisation.

If it is true that magnetisation penetrates to depths so much the greater as the discharge is more intense, then on passing two successive discharges in opposite directions, the second being the stronger, this latter should produce the same magnetisation as if the former had not existed; which is confirmed by experiment. But if the second discharge is the weaker and does not penetrate to the axis, it may give a nul or a negative result. On corroding the needle with hydrochloric acid, we should then find in the superficial layers the magnetisation produced by the second discharge, and in the deeper parts the magnetisation produced by the former, as it is again verified by experiment. If we submit one and the same needle to discharges progressively decreasing, and which are in contrary directions, the first alone magnetising the needle to the axis, then on corroding the needle with hydrochloric acid, we find successively all the magnetisations corresponding to the different discharges.

I believe that I have demonstrated in the foregoing, that currents of very brief duration, produced by the discharge of condensers, magnetise steel like other currents, in conformity with the law of Ampère. Whenever the discharge is continuous, the south pole is to the left hand of the current. In the case of oscillating discharges, the needle receives at depths progressively decreasing magnetisations alternately in opposite directions. The first ones may penetrate to the axis and thus destroy each other completely. The resulting magnetisation may be sometimes in one direction and sometimes in the other, according to the direction of the last of the magnetisations which have penetrated to the centre and that of the superficial magnetisations. The direction of the resulting magnetisation depends evidently in great part on that of the superficial layers, whose section, for a given thickness, is much greater than that of the deeper strata.

This is the explanation of the anomalies observed by Savary.—*Comptes Rendus.*

The Society of Telegraph Engineers and Electricians.—A meeting will be held at the Institution of Civil Engineers, on Thursday, November 28th, when the following paper will be read: "On the necessity for a National Standardising Laboratory for Electrical Instruments," by J. A. Fleming, M.A., D.Sc., Member.

ON SOME PRACTICAL ELECTRICAL FORMULÆ.

(*For use in Constructing Circuits, Electro-magnet Coils and Dynamos.*)

By F. V. ANDERSEN.

PART II.

On an Electrical Figure of Merit of Dynamos.

A.—*The* F *of a Dynamo.*

Let W = activity in watts of a working dynamo;
E = electromotive force in volts induced in armature conductor;
C = current in ampères taken off the brushes;

then $$W = E \times C.$$

Considering a two-polar dynamo with a gramme commutator

$$E = m \times \sin\phi \times \mu \times V \times \frac{L}{2}$$

where m = density of lines of force of field;
$\sin\phi$ = average value of sines of the angles, at which each turn of armature-conductor is cutting the lines during a revolution;
V = average linear velocity of total armature-conductor;
L = length of armature-conductor (total);
μ = a constant depending upon the units in which V, m and L are expressed.

If we put

$$m \times \sin\phi \times \mu = F$$

then F will stand for volts per unit length of armature-conductor travelling at unit velocity, or, in a dynamo of above description

$$F = 2\,\frac{E}{V\,L} \qquad \text{I.}$$

$$E = F\,\frac{V\,L}{2} \qquad \text{II.}$$

$$W = F\,\frac{V\,L}{2} \times C \qquad \text{III.}$$

If we take V in feet per second and L in feet, then F means volts per foot of armature conductor going one foot per second. These are the units of which I shall make use in the following lines for V, L and F, respectively.

By careful tests of a number of different dynamos, of which details of construction, such as the exact dimensions of the armature core, the length and section of armature conductor, &c., were known to me at the time, I have found:—

1. That F can be considered a constant for dynamos of similar construction, although of very different sizes, if the same percentage of their total activity is used for exciting them.

2. That there is an enormous difference between the respective values of F for the different types of dynamos which are now in the market.

Now the activity as well as the electrical efficiency of a dynamo depend, as I shall show hereafter, on F in so simple a manner, that it is easy from the value of this quantity to derive the true electrical merit of different dynamos. I think such a figure would be of great use to all who are working for the improvement of this comparatively new class of machinery, be it as constructors or as testers, not to speak of the interest it would have to the users of dynamos to be able to, by a simple test, compare the merit of one type with that of another. Further, such controversies as have taken place occasionally in the technical journals as to the value of certain constructions—*exempli gratia* the Ball unipolar—would, if electricians had agreed upon a general figure of merit, be more likely than they are at present to terminate in a practical result. Finally, several highly important questions as to principles of construction can be solved by directing attention to

the information contained in the value of F of a dynamo; for instance, the question whether the Gramme ring has a portion of its armature wire useless.

B.—*How Activity and Efficiency depend upon* F.

Let a = ampères per square inch in armature conductor;
s = cross section in square inches of ditto ditto;

then $$C = 2\,s\,a$$

and from formula III.

$$\text{activity, } W = F\,V\,L\,s\,a \qquad \text{IV.}$$

So the activity of a dynamo, *i.e.*, its capacity of converting energy, is proportional to its F. The activity is further proportional to the velocity of the armature conductor, and to the weight of this conductor carrying a certain number of ampères per square inch. As a rule, dynamos constructed for similar purposes would within a considerable range of sizes not need to vary much from one another with regard to the velocity at which the armature wire could be rotated, nor to the ampères per square inch which could be carried by this wire. Strictly speaking, we should in determining the electrical merit of a dynamo, eliminate the velocity as a mere mechanical condition, and load the different dynamos until they would work at a standard temperature, which should be a maximum safe temperature for continual running, and then measure a. This quantity could not, however, come to count directly in the merit; for, as we shall see hereafter, if the activity is proportional to a, so is the percentage of waste in the armature, and the figure of merit must be a function of both these quantities in inverse sense.

In relation to activity, F therefore stands for the electrical merit of the individual machine. A high value of F means a comparatively powerful machine; a low value for F the reverse. A dynamo with a low F can only give good activity by higher velocity than ordinary.

The next formula to consider is that of electrical efficiency. We shall find that this is in the same direct manner influenced by the value of F.

First let us consider the simplest dynamo, the magneto machine, in which the field is formed of steel magnets receiving no current for excitement, in which, therefore, the total waste is that which takes place in the armature.

If $w\,a$ = watts wasted in armature,

then

$$\text{Electrical efficiency} = \eta = \frac{W - w\,a}{W} = 1 - \frac{w\,a}{W} \qquad \text{V.}$$

Now $$w\,a = C^2\,r\,a$$

and $$C = 2\,s\,a$$

and $$r\,a = \frac{\kappa\,L}{4\,s}$$

so $$w\,a = 4\,s^2\,a^2\,\frac{\kappa\,L}{4\,s} = s\,a^2\,\kappa\,L$$

and from this and formula IV. and V.:

$$\eta = 1 - \frac{s\,a^2\,\kappa\,L}{F\,V\,L\,s\,a} = 1 - \frac{a\,\kappa}{F\,V} \qquad \text{VI.}$$

Or in per cent.:

$$\eta = 100 - 100\,\frac{a\,\kappa}{F\,V}$$

So the percentage of internal waste in this dynamo is inversely proportional to F, while the activity, as we have seen, is directly proportional to F.

Now the figure on which depends the activity directly the percentage of waste inversely is a true expression for the merit of the machine. I propose, therefore, to express the electrical merit of magneto machines by the figure for F.

Suppose in one magneto machine $F_I = \cdot5$, in another $F_{II} = 1\cdot$, and suppose these two machines are put to work under the same conditions, *i.e.*, running at the same velocity and giving out the same number of ampères per square inch of armature conductor, the latter will convert double the amount of energy and waste half so many per cent. of what it converts as the former, *i.e.*, it will waste the same number of foot-pounds per second as the former, while it is doing double the amount of work in equal space of time. It will therefore, from an electrical point of view, considering that it contains the same amount of copper wire, be just to express its merit as twice that of the former machine.

We shall now proceed to deal with the ordinary sort of dynamos, those in which the field is formed of electro-magnets in which a certain amount of energy is expended. It makes no difference to the result whether this extra amount of energy is taken from the machine itself or derived from another source.

In such machines F becomes a function of the additional waste, because F can be made to rise by expending more energy in the field. F does not, therefore, express the merit of a machine of this sort; it must undergo a certain reduction to serve for the purpose.

(*To be continued.*)

COMPETITIVE TESTS OF DYNAMOS.

IN the REVIEW for September 12th, we commenced the republication of the Report of the Franklin Institute of America on the efficiency and duration of the incandescent electric lamps which were shown in the Philadelphia Exhibition last year. In successive issues we placed before our readers full particulars of the methods of testing, and of the results at which the committee arrived.

We have now before us the latest number of the Franklin Institute Journal, which contains a report emanating from the same scientific body on the competitive tests of dynamos exhibited at the same time and place. The committee of judges consisted of Louis Duncan, Ph.D., Ensign, U. S. Navy, chairman; William D. Marks, Whitney Professor of Dynamic Engineering, University of Pennsylvania; George L. Anderson, Lieut. U. S. Army, Instructor of Mathematics, U. S. Military Academy, West Point; J. B. Murdock, Lieut. U. S. Navy; and A. B. Wyckoff, Lieut. U. S. Navy, Hydrographic Office, Philadelphia.

Commander Jewell, U. S. Navy, acted as chairman at the beginning, and rendered valuable assistance and advice in the preliminary preparations. Owing to unavoidable delays, however, the tests were not begun before his paramount duties at the U. S. Torpedo Station compelled him to withdraw.

The conditions of the code were severe upon the judges, requiring protracted runs of the machines, and immediate calculations of results. The labours of the committee were therefore incessant, and were performed with such zeal, intelligence, fidelity and success as to satisfy the President of the Institute that no praise could exceed that to which a careful examination of the report of their work will entitle them.

The tests were conducted under the following code, agreed to by the contestants:

CONSTRUCTION OF THE MACHINE.

Diameter of armature;
Weight of machine;
Number of commutator bars;
Turns and length of wire in armature coils;
Whether brushes must be adjusted, or are automatic for different currents;
Diameter and length of bearings;
Number of turns per minute;
Number of volts for best work;
Number of ampères for best work.

PRELIMINARY TESTS.

The resistance of the field magnet coils and of the armature coils will be measured as follows: A strong current from a secondary battery shall be passed through these coils and ampèremeter and sensitive voltameter used to determine current and fall of potential. The resistance will be determined from these measurements. As an additional precaution, a strip of German silver of known resistance shall have its fall of potential measured with the same current and instruments. These measuroments shall be made before and after the tests, with the machine hot and cold.

INSULATION RESISTANCE.

Tests will be made of the insulation of the terminals of the machine from its metal bed plate.

Tests will be made of the insulation resistance between the commutator and the axle.

It is understood between the parties that if any mechanical defect is observed, another machine may be substituted if the committee agree that such defect exists.

The competitors shall have reasonable opportunity to obtain information of the progress of the tests, and to know the figures of each test for the object of ascertaining errors in time for correction.

The observations made will be publicly posted before the machine is removed from the dynamometer.

Calibration of Instruments.

The constants of all instruments used shall be determined by at least two independent methods. The companies shall have opportunity to inspect and observe the methods used and shall be furnished with the constants of the instruments immediately after they have been determined.

Quantitative Tests.

The dynamo to be tested will be run under full load for ten hours continuously, to see that all is in good working order before the tests begin.

For the actual test the machine shall be run and the temperatures of the pole pieces and armatures observed until a uniform temperature is reached.

When a uniform temperature for each load is reached, the measurements of power shall begin.

The machine will be tested on both live and dead resistances.

The machine will be tested on one-quarter, one-half, three-fourths, and full load. In the latter case, to be run at least five hours after a uniform temperature is reached.

Full measurements of friction and of energy expended in field will be made in each case.

In all determinations of efficiency of machines, measurement of potential shall be made (simultaneously with measurements of the current streugth) at the binding posts of the machine, and at such other points of the circuit as will determine the total fall of potential, due to the resistance of the leads, connections and switches included in circuit with the instruments used for determining current strength. From these measurements the loss shall be calculated and credited to the machine under trial.

Fig. 1 gives the general arrangement of the apparatus. The test room, in which most of the instruments for electrical measurement were placed, was in about the middle of the Exhibition building of the Franklin Institute. The dynamos, with the boiler and engine used in running them, were in a shed at one corner of the building; and the resistances for their external circuit—lamps and German silver strips—in a room inside the building and very near the shed.

The storage battery, tangent galvanometer for current calibrations, and galvanometer for measuring field currents, were in different parts of the building, far enough from the test room not to affect the instruments in it.

The leads from the dynamos and storage battery, and to the tangent galvanometer were of heavy, insulated copper cable. They were taken to the corner of the test house farthest from the instruments, and where they approached it the two parts of a circuit were twisted together, one of them being covered with rubber tubing as an additional precaution against leakage. Even with the heaviest currents (about 400 ampères) there was no effect

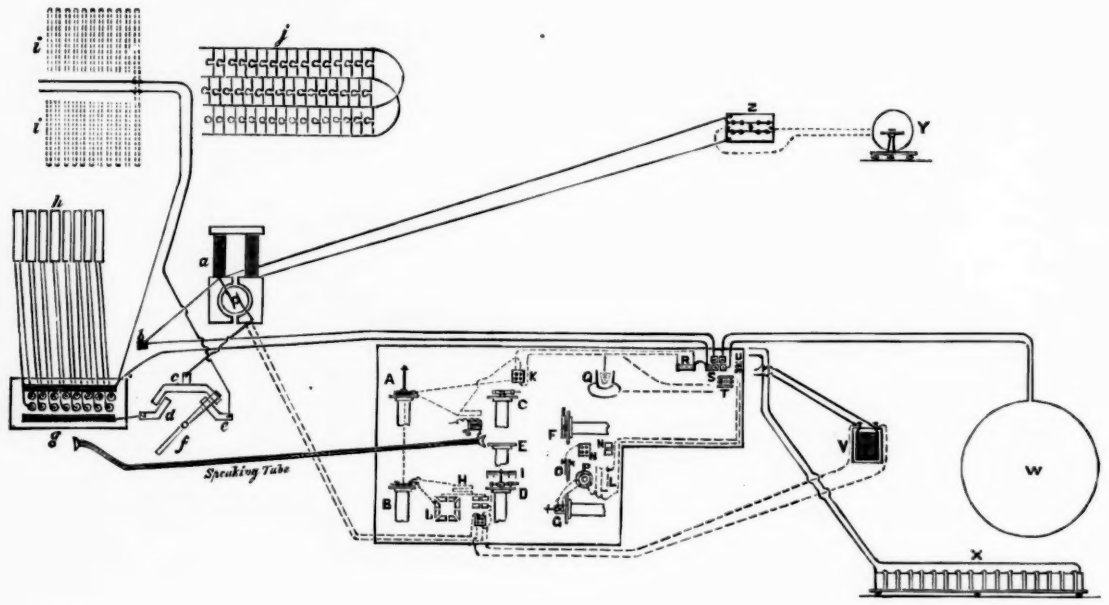


Fig. 1.

A, Current galvanometer; B, Potential galvanometer; C and D, Telescopes and scale; E, Spare pier; F, Telescope; G, Galvanometer for resistance measurement; H, Bergmann resistance box; I, Scale; J, Elliott box (100,000 ohms); K, Commutator; L, Resistance box (bridge attachment); M, Battery for bridge; N, Commutator; O, Double contact key; P, Shunt; Q, Silver voltameter; R, Fixed resistance; S, Mercury cups; T, Calorimeter; U, Mercury cups; V, Potential resistance; W, Tangent galvanometer; X, Storage battery; Y, Field galvanometer; Z, Commutator; *a*, Dynamo to be tested; *b*, Mercury cup; *c*, *d*, *e* and *f*, Edison switches; *g*, Switch board; *h*, German silver resistance; *i*, Edison lamps; *j*, 48 Weston Mammoth lamps.

N.B.—The relative position of objects outside of "Test House" is distorted to bring the drawing within reasonable compass. Distance between instruments A and B, 7 feet 3 inches; distance of telescopes, 8 feet 4 inches; distance from test house to boiler house containing dynamo on trial, 189 feet; the field galvanometer, Y, is situated 60 feet from the centre of test house; and W, the tangent galvanometer, 150 feet from test house.

Dynamometric Measurements.

The shaft of the dynamo will be directly attached to the end of the shaft of Tatham's dynamometer, by means of a universal joint coupling, and the horse-power used read from the dynamometer, unless the committee, for reason, shall decide otherwise.

Observations.

The observations on the dynamometer, current galvanometer, and potential galvanometer, and all other instruments, will be taken at synchronous intervals.

The temperature of the room will be made as even as possible, and the temperature noted and necessary corrections made.

The adjustment and oiling of machines shall be in the hands of the authorised expert for the company.

In case any objection be made, or difference of opinion should arise between the committee and the contestants, the unanimous vote of the committee shall be final.

If, however, there be not a unanimous vote, the minority of the committee shall appoint one referee and the majority another; these two shall appoint a third referee.

The decision of the majority of these referees shall be final.

on the instruments, and calibrations made both when the dynamos were and were not running, showed that any disturbance from currents in the leads had been avoided.

Before any measurements were made the insulation resistances between the leads themselves, and from the leads to the ground, were carefully tested and found in every case to be over 50 megohms; and measurements at intervals during the tests showed that they remained about the same.

Observations.

The power applied to the dynamos was measured by a Tatham dynamometer, while the electrical energy was calculated from observations of the potential at the terminals of the machine, the currents in the external circuit and field, and the resistance of the armature. The latter was measured by sending a current from a storage battery through the armature and observing the current in the circuit and fall of potential between the terminals of the machine.

The dynamos were run both on lamps and dead resistance, the value of the latter serving as a rough check on the potential and current,

APPARATUS.

Storage Battery.—This was kindly furnished by Mr. Weston, and was used for all calibrations, measurements of armature resistance, &c. Seventeen cells in series were generally employed; they were placed on boards separated from the floor by porcelain insulators.

Tangent Galvanometer.—This was used for calibrating the current galvanometer. It consisted of a single turn of large-sized wire fastened on the edge of a wooden disc which was nailed against a square board frame. The ends of the wire were bent up parallel to each other and fastened by brass connectors to the leads. A correction due to the space between the ends of the turn was applied to the mean radius.

The diameter, about two metres, was measured in different directions, and the mean taken in calculating the constant.

There was a space cut in the middle of the wooden frame, with a shelf for the compass and needle. After the needle was adjusted to the centre and levelled, plumb lines and pointers were arranged so that any warping or change of level could be at once detected.

The value of H was determined by a magnetometer of the Coast Survey pattern with detached theodolite; it was found to be ·1938 and the constant of the galvanometer 31·088 ampères.

External Resistances of Dynamos.—The "dead" resistances for the external circuit of the dynamos were made of German silver strips 1¼ inches wide by about ·01 inch thick. They were eight in number, each wound on a frame about 3 feet square by 10 feet high, made of four wooden uprights with pieces framed across at the top and bottom. Porcelain insulators were fastened horizontally to the cross pieces and the resistances passed under one of the bottom insulators, over one at the top, to the bottom again, &c. Heavy copper wires were hard soldered to the ends of the strips and taken to the switch board.

The resistances were adjusted by cutting out part of the strip by a short length of German silver with clamps at the ends, which could be shifted to cut out as many of the turns as was desired. The coils were adjusted by means of a calibrated bridge, to 2·400 ohms at 20° C. There was a good air circulation in the room and 50 ampères could be carried by each coil.

In the same room with the German silver resistances were the racks for the incandescent lamps used for "live" resistances.

Switch-Board.—Two troughs about 2½ feet long and 1½ inches wide, and 10 inches apart, were cut in a heavy block of wood. Between them were bored two rows of eight holes each, and into these were fitted glass insulators turned upside down to serve as mercury cups. The wood was soaked in boiling paraffin, and melted paraffin poured between the cups and allowed to harden. The distance between the troughs and the middle of the nearest row of cups was 3½ inches; between the two rows, and the cups in each row, 3 inches. The cups and troughs were filled with mercury, heavy amalgamated copper rods in the latter serving to increase the conductivity. The resistances were brought to opposite cups in the two rows.

The dynamo circuit was from one terminal of the machine to an ordinary Edison switch, by which the current could be made or broken, to one of the troughs; through the resistance to the other trough; to the test house, passing through the fixed resistance for current measurement there; back by the other lead to the dynamo.

Connections at the switch board were made by thick U-shaped copper rods, with a stretch of 3½ inches. The resistances could be readily arranged in any desired way, with little or no chance of causing accident by making mistakes. The insulation between the troughs and the cups and the troughs themselves was practically perfect.

Field Galvanometer.—The current in the field of the dynamos was measured by a tangent galvanometer of the Helmholtz type, the coils being each a single turn of large-sized wire. It was calibrated at the same time as the current galvanometer, being reversed as often as possible, and the same end of the needle read on each side of the zero mark.

Wheatstone Bridge.—For measuring resistances that could not be taken to the Johns Hopkins University, a resistance box, with a bridge attachment by Elliott, of London, was used, with a Thomson astatic mirror galvanometer. The box was standardised.

Calorimeter.—This was used for calibrating both the potential and current galvanometers; it was made of copper, was cylindrical in shape, about 8 inches in diameter by 10 inches in height, and held about 18 lbs. of water.

The cover was screwed to a flange on the cylinder, the joint being water-tight; in it were holes with raised flanges around them, for the terminals of the coil and the thermometer. For stirring, a shaft, working in a bearing on the bottom of the cylinder and passing through the cover, had on it five paddles arranged along its length and at different angles around it, and bent to throw the water past the wire out to the side of the vessel. On reaching the side, a downward motion was given to it by strips of light copper, making an angle of about 30° with the vertical, soldered to the cylinder and projecting inward one and one-fourth inches. On the bottom of the shaft was a propeller blade. Putting saw-dust on the water and turning the shaft slowly showed the circulation to be excellent. Turning the wheel belted to the pulley on the shaft three times per second, raised the temperature of the calorimeter ·02° C. in five minutes. In the later experiments it was only turned once per second, so the error from this correction must have been small.

In the first three experiments, copper wire of about 1·3 ohms resistance was used; in the last two, platinum-silver wire of 1·1 ohms. The coil was held in the cylinder as follows: At equal distances around the cylinder, at the top and bottom, were soldered pieces of copper projecting inward, with clamps at their ends. The wire was wound on glass rods held in a light framework: the whole was placed in the cylinder, the rods clamped in place and the framework cut away, leaving a clear space for the stirring arrangement.

The terminals were small copper cups, thoroughly amalgamated and partly filled with mercury. They were surrounded by a rim of ebonite and wedged in their places in the cover.

The calorimeter fitted in a light iron frame, from which it was separated by small blocks of ebonite. The whole was surrounded by a tin cylinder fitting closely on the shelf to which the frame was fastened, so there was no draught past the cylinder.

Balances.—Two balances were used, one for weighing the calorimeter, the other in voltameter work. The former could weigh up to thirty pounds and was very sensitive. The latter was an excellent analytical balance. Both were by Trœmner, of Philadelphia, and the weights were compared with standards in his possession.

Thermometers.—The thermometers generally used were by Green, of New York. They were divided into degrees and tenths, and were compared at the Johns Hopkins University with one of the standards there, the apparatus used in the comparison being that described by Professor Rowland, in his "Determination of the Mechanical Equivalent of Heat." For the last two calorimeter experiments, a thermometer by Hicks, of London, was used. It was graduated to centimetres and millimetres, and was one of those used by Mr. Leibig, in his work "On the Variation of the Specific Heat of Water."

Potential and Current Galvanometers.—These will be described under measurements of potential and current. They, with the other instruments in the test house, rested on stone slabs cemented on the top of heavy wooden posts, sunk about two and one-half feet in the ground.

METHODS OF MEASUREMENT.

MEASUREMENT OF RESISTANCE.

For the standard resistance, a ten B. A. unit coil by Elliott, which had been compared at the Cavendish laboratory, and was used by Professor Rowland in his recent determination of the ohm, was employed. The values of the resistances in terms of this coil were reduced to the Paris ohm, by dividing by 1·0112.

The bridge used in the comparisons was built at the University Workshops, Cambridge, England. Its fixed (equal) arms were connected by a platinum-silver wire bent in a circle, and their ratio changed by making contact with the galvanometer circuit at different points on the wire. Besides the wire was a scale, and on the arm carrying the galvanometer contact, a vernier reading to tenths of a division. When the fixed coils were each one ohm, a whole division of the scale meant a change of one part in 10,000 of the ratio, while with the galvanometer used, a change of one-tenth of a division, or one part in 100,000 could be detected. The bridge had been calibrated for use in the determination of the ohm. With fixed coils of one ohm, the range of the instrument was about ten per cent., so the resistances to be compared were always approximately equal.

The different coils to be compared were balanced against resistances taken from "comparators," designed by Prof. Rowland. Each of these consists of ten coils of equal resistance wound together on a copper cylinder, the whole being coated with wax or paraffin and put inside a larger cylinder, the space between being filled with feathers. At the top, the cylinders are separated by an annular sheet of hard rubber, around which two circles of ten holes each are bored for the terminals. The ends of each coil are taken to copper blocks screwed firmly beneath opposite holes in the two circles. The tops of the copper blocks are thoroughly amalgamated and the holes partly filled with mercury, connections being made by short U-shaped copper rods.

Three comparators of 10, 100 and 1,000 ohms were used, giving a range of from one to 10,000 ohms.

Each coil of the ten-ohm comparator was balanced directly against the ten-ohm standard, then the ten coils in series were balanced against each of the 100 ohm coils, and finally the 100 ohm comparator in series compared with each of the 1,000 ohm coils. In the measurements, the inner cylinders of the comparators were filled with water and the standard immersed in water, the temperatures being noted.

The zero of the bridge scale was taken as the mean of the readings when the resistances being measured were reversed.

In measuring the resistance boxes, they were kept for six or eight hours in a room whose temperature was nearly constant, and then balanced against corresponding resistances taken from the comparators, the temperatures being, of course, noted.

The coil for potential measurement was immersed in turpentine, its temperature recorded, and its resistance measured as above.

The resistances compared at the Johns Hopkins University were the box for current measurements, the coils and bridge for measuring resistance, and the coil for potential measurement.

MEASUREMENT OF POTENTIAL.

The galvanometer used for potential measurements was by Hartmann. It was furnished with a Siemens bell magnet, closely surrounded by a solid copper block, and damped very readily, only making two or three swings before coming to rest. The suspension was a silk fibre about 15 centimetres long. The coils,

specially wound over the regular winding of the instrument, had a resistance of about 2 ohms.

The galvanometer was in a circuit with resistances that were varied from 1,000 to 150,000 ohms, taken from boxes, two of 100,000, one of 10,000 ohms, the former by Elliott and Breguet, the latter by Bergman. All calibrations being made with the (30,000 + 20,000) Elliott coils in the circuit, it was necessary to compare the other resistances with these coils. The arms of the bridge being made equal, the (30,000 + 20,000) and (40,000 + 10,000) Elliott coils were balanced in succession against the 50,000 Breguet, resistances being added to one or the other until there was no deflection of the galvanometer. It was found that

50,000 Breguet = (30,000 + 20,000 + 280) Elliott.
50,000 Breguet = (40,000 + 10,000 + 250) Elliott.

The (30,000 + 20,000) ohms Elliott was also measured in terms of the bridge coils, and the value found, 49,960, was so nearly correct that in getting the ratios of the 1,000 and 2,000 ohms Bergman—used in measuring armature resistance—to the (30,000 + 20,000) coils, it was assumed that their values in terms of the bridge coils were the same as if measured in terms of the (30,000 + 20,000) ohms.

The deflections were read by a telescope and scale, the latter by Brown and Sharpe, graduated to centimetres and millimetres. The distance from the telescope to the mirror was two and one-half metres.

Calibrations.—The galvanometer was calibrated, both by measuring a current passing through a standard resistance at whose terminals the leads of the instrument were connected; and by the difference of potential at the terminals of a calorimeter. The constant was also checked with that of the current galvanometer, after each test, by measuring the current through the German silver strips used for the external circuit of the dynamos, and the potential at their extremities.

During the tests 40 calibrations were made; 36 with the silver voltameter and standard coil, and four with the calorimeter. The constants determined by the calorimeter agreed so closely with the measurements by the voltameter, and the labour both of observation and calculation in the former was so much greater than in the latter, that it was thought unnecessary to make the observation any oftener.

Voltameter Calibrations.—The current used varied from one to one and one-half amperes, giving a difference of potential at the terminals of the standard coils of from 20 to 30 volts. The coil shown in fig. 1 was of No. 22 German silver wire, wound on glass rods fixed in a wooden framework. The turns were kept apart by silk cord wound on the rods. The whole was immersed in a high grade oil (300° fire test) kindly furnished by the Standard Oil Company. The oil was constantly stirred while the current was passing. The measurement of the resistance has been described. Its value was 21·161 ohms, at 14° C.

For measuring the currents, a silver voltameter was used, the anode being a spiral of silver wire wrapped in filter paper, the cathode a platinum crucible filled with a 40 per cent. solution of silver nitrate. The calibrations took from 10 to 20 minutes, the deposit ranging from ·9 gram to 2· grams. The times were noted by a chronometer whose rate, + 1 second per day was neglected.

When the experiment was finished, the solution was poured out of the crucible; the deposit first washed with distilled water, then allowed to soak from one-half hour to 12 hours, then washed again until there was no precipitate with a solution of sodium chloride, and finally slowly dried and then weighed.

A double reading of the galvanometer was taken each minute, and the constant calculated from the mean reading for the time of observation. The constant is given by

$$k_{50} = \frac{C\,R\,(1 + M_c\,(t_c - 14°))}{2\,d}\left\{1 - M_b\,(t_b - 25°)\right\}$$

where

k_{50} = constant for (30,000 + 20,000) ohms;
R = resistance of standard coil at 14°;
t_c = temperature of standard coil;
M = temperature coefficient of standard coil;
M_b = temperature coefficient of box;
t_b = temperature of box;
$2\,d$ = double deflection of galvanometer;
25° being taken as the standard temperature of the box.

When other resistances were used in the circuit, the constant was multiplied by their ratio to the (30,000 + 20,000) ohms.

Calorimeter Calibrations.—The calorimeter has been described. In making the observations, the time the mercury crossed each half degree or centimetre of the thermometer was taken as the mean of the times of crossing the tenths before and after the division, and the division itself. In calculating the water equivalent of the calorimeter, the weight of the shaft was multiplied by the specific heat of steel; that of the cylinder by the specific heat of copper, and the weight of the glass and wire, by their specific heat. For steel, the value of the specific heat was assumed to be ·1110 and that of copper ·0940.

The principal correction to be applied is due to radiation. The other corrections are for rise of temperature from stirring, for the part of the thermometer stem in the air, and a small one for weighing in air.

The coefficient of radiation was determined by noting the rate of cooling, the calorimeter being slowly stirred. Experiments gave—

Difference between air and calorimeter,	10° C.	coefficient, ·00154
" " " " "	5° C.	" ·00150
" " " " "	0° C.	" ·00149

Before the experiments, and for the determination of the radiation, the cylinder was carefully polished.

The correction for stirring was determined by bringing the calorimeter to exactly the temperature of the air, and then turning the wheel belted to the pulley on the shaft three times per second. The rise of temperature was ·02° in five minutes. For the smaller velocity used in the later experiments, the heating was assumed to vary as the cube of the velocity.

The correction for the temperature of the stem was taken from

$$c = ·000156\,n\,(t - t'')$$

In making the calculations, Rowland's value of the mechanical equivalent was taken, because the thermometers used in the above experiment were compared directly with those employed by Prof. Rowland, and thus errors in the thermometry were to a large extent eliminated.

Probably the greatest source of error in the calorimeter experiments was the superheating of the wire in the water. Using platinum-iridium wire varnished, with a smaller current than was generally employed in these experiments, Mr. L. B. Fletcher calculates that the superheating is about 2° C. But in the measurements described above the wire was bare and the flow of water passed it very much faster than in Mr. Fletcher's work. In the last two experiments a rise of 2° C. would cause an error of less than one-tenth per cent., so it is probable that they are not much effected by this source of error.

It is also possible that there was conduction through the water. The calorimeter was carefully cleaned before each experiment and distilled water used. If such an effect existed, it would be in an opposite direction from the superheating.

The usual range of temperature was 10° C.; in the experiment given it was a little over 6°.

Besides the regular calibrations, the constant was calculated after each test, from the potential at the extremities of the German silver "dead resistance," the current being measured by the current galvanometer, and the resistance measured by the bridge.

For the Edison Nos. 5 and 10 dynamos, the potential galvanometer was in the same position as when used for the duration test of lamps, in a room at some distance from the test house. The constant as determined during the tests of these machines agreed closely with that used in the duration tests, which had but just ended. But when the instrument was removed to the test house, the constant began to vary, changing greatly from day to day, with sometimes a sharp change during the day. The Weston No. 7 M dynamo was tested on full load with the constant in this unsatisfactory state, and between the second and third tests there was a change of over one per cent. Although the number of calibrations made these measurements perfectly trustworthy, yet the labour and anxiety were both too great to be repeated with each test.

So before the machine was run on the partial loads, the galvanometer was taken to pieces, the coils rewound and soaked in paraffin, and the stand of the tube carrying the suspension more firmly secured. A beam, which pressed against the wooden pier, was also cut away. After this, the constant did not vary, the calibrations rarely differing more than one-tenth per cent. from the constant used.

(To be continued.)

LEGAL.

Re Oppermann Bros.—Court of Bankruptcy, Thursday, November 12th. (Before Mr. REGISTRAR HAZLITT.)—Carl Tunstall John Oppermann, whose public examination was conducted by Mr. Cooper-Willis on behalf of a creditor, stated that he and his brother commenced business in London as electrical engineers, in 1881, with only about £5 capital. They worked themselves at the business for a time. Subsequently Messrs. Kelly & Co. put £500 into the business, for which they were to receive a share of the profits; this money was not to be called in before 21 years had elapsed, unless a heavy indemnity were paid. His brother went to America in September of last year and opened a branch business in Chicago. A balance sheet was made out at the commencement of the present year, which showed that there were profits to the extent of £391 12s. 2d. on the trading up to that time; there was a profit in one sense of the word profit.

Mr. Cooper-Willis: In what sense do you mean?—As far as the accounts were made out. That was based on the assumption of the stock being worth more than it really was.

Do you suggest that you gave wilfully an excessive valuation of the stock?—Not wilfully; I took it at what I considered a fair value in the state in which the market was then.

Did not Messrs. Kelly's accountant object to the high value you put on the stock?—I do not recollect that he did.

Just think? Did you not tell the accountant that you had sold similar stock at higher prices?—Yes; I think I may have.

And was not that the reason you gave him for putting a high value on the stock?—Well, yes; it was on the prospect of its realising that.

Now, as a matter of fact, had you sold stock previously similar to that at the prices you put upon them?—I had.

Does that appear in your books?—Yes. Continuing, Mr. Oppermann said Messrs. Kelly were credited with £130 10s. 8d. upon that balance sheet as their share of the profits, but the money was not handed over. At that time he believed himself perfectly solvent. His deficiency now amounted to £922. Between November, 1884, and June of the present year, he consigned goods to the amount of £582 12s. to his brother at Chicago. These, in his books, appeared to be consigned to the firm of Lapp and Flearsham. They were the people who were advancing money to his brother; they were to receive the goods, pay the duty on them, and hand them over to his brother, who had given the order and requested him to send the goods in the manner described. He did not know whether his brother had sold those goods, nor was he sure whether he had any letters of his brother's relating to them. He had never sent goods to America without an order from his brother. The invoice was made in the name of Lapp and Flearsham, but was sent to his brother. Lapp and Flearsham were jewellers, of 81, State Street, Chicago. The goods were invoiced to them at a slightly increased discount.

Why is it the ledger does not show the prices at which they were invoiced?—The ledger shows the price which we were supposed to receive for the goods.

Why is it the ledger does not state the truth?—I do not know; there was no reason for doing it.

Are you aware that the ledger does not contain the correct entries with regard to those goods?—In my opinion the ledger contains the correct entry—the amounts we are supposed to receive.

Why should you consign goods to Lapp and Flearsham at a slightly increased discount from that at which you enter them in the ledger?—It is the custom of the trade to do it.

I may take it that there are no figures appearing in your book showing the exact transactions with your customers?—No, you cannot take that at all, because they all do.

Consigning goods to Chicago, would the invoice prices be more or less than those appearing in your ledger?—If the price in the ledger were £17 2s., the invoice price might be £16 2s. The goods referred to were supplied at 15 per cent. discount.

I want to know why you supply goods to your brother as a partner, at a less price than to other people?—So that he could get them into the country at a reduced rate.

The idea was, then, to defraud the American revenue by getting them into the country at a slightly reduced rate?—It is no question as to whether it is a fraud on the revenue.

Did you have any contracts with Lapp and Flearsham to buy these goods?—I am not aware of any.

Why did you invoice to Lapp and Flearsham?—So that the goods could be got into the country at a reduced duty.

How could that be done?—Because Lapp and Flearsham have big friends in the Customs (laughter). Continuing, he said he had received no account from his brother since November, 1884, as to what had been done with the goods sent him, although he had repeatedly applied to him; he had not received a single penny on the account. In his books there were no entries after the 5th of September, but the business was carried on after that date. He himself was away from England at that time. He left on the 1st of September to go to Grimsby, to superintend some experiments on a steam trawling vessel, with the view of ascertaining if the electric light would attract fish. With that idea he went on board a fishing smack, with the understanding that he was to return in two or three days. Unfortunately they were overtaken by a storm, and drifted about the North Sea for several days. He landed in Denmark and afterwards went to Christiansand in Norway, returning to England by boat from there. He borrowed £20 from his father to go on this expedition. There may have been £20 belonging to the firm at the bank at the time, but he knew that a bill was coming due in a few days. He knew what his financial position was, generally, when he went away, but he did not consider he was insolvent. He only filed his petition as a last resource to prevent the creditor who put a man in possession during his absence taking everything. He was married on the 17th September, the day after his return from Norway. A settlement of his furniture was made upon his wife; this settlement was drawn up before his departure for Grimsby. This furniture he had bought with money borrowed from his father and father-in-law a month before he went away. He had not repaid any portion of either of the sums lent him by his father. At the time he purchased the furniture he believed he was solvent, but he did not take the money from the firm, because he had no right to do so; he only drew his wages from the business. He made an affidavit, on the filing of his petition, that he had his brother's consent to the course. That consent was contained in a letter, and he also acted upon the general consent understood in arrangement made when his brother left England. He did not write asking his brother in so many words for his consent to filing a petition, but threatened him that if he did not remit anything he should be obliged to do so. That was about three months before, but he did not then believe that he was insolvent. His brother replied that it would be a bad job if he was compelled to such a thing. That was the letter on which he based his affidavit; that and the authority understood from the fact that he had full and sole control of the business, and was to do the best he could. He informed his brother by cablegram that he had filed a petition the day after he had done so, but had received no communication in reply.

Are you aware that your brother has stated in an interview at Chicago that he knew nothing personally about the failure of the London firm, and that it came as a surprise to him?—My attention has been called to that, but it is utterly unfounded. I know it is untrue that our affairs were in such a flourishing condition that we could pay $10 for every $1 we owed.

An extract from the New York *Electrical Review*, containing an account of an interview with his brother, was handed to Mr. Oppermann, and he asserted that the statements in that report were incorrect. He did not know whether the Chicago firm was solvent or not. He borrowed £15 of a Mr. Ramsden about the time of his marriage. Mr. Ramsden was a secured creditor. He did not pay that money to his father, but used it in his business. A portion of the plant was sold by the landlord, and he (witness) had received none of the money.

Mr. Cooper-Willis stated that the first meeting of the creditors was not yet concluded, and therefore Mr. Oppermann could not pass his examination. Irrespective of that his client, and no doubt the official receiver also, required a statement of affairs, including a proper statement of accounts from the brother, who asserted that the Chicago house was solvent.

The examination was then adjourned until December 17th at 11 o'clock.

NOTES.

The Electric Light in Street Decoration.—The Prince and Princess of Wales will visit Birmingham next Friday to open the Jaffray Suburban Hospital, and the new Municipal Museum and Art Gallery, and preparations are in progress for effecting the decoration of the streets; amongst other things we see it stated that there will be illuminations, in which the electric light will play a prominent part, in all the principal thoroughfares on the night of the 28th inst.

Electric Lighting in New York.—According to a New York contemporary, the average traveller must now deem that city pretty thoroughly lighted with electricity. Along the river fronts, up Broadway, through the principal avenues, along the streets leading to the ferries, and in the city parks, over the East River bridge, together with a large number of private lights, notably on the Bowery, it will be readily seen that those portions of the city which come under the eye of the casual visitor are thoroughly illuminated. Should it eventually prove true that the existing companies will abandon arc lighting rather than place their wires underground, it is pretty certain that the public will not be ready to return to the old system of street lighting. The business is now amicably divided between the Brush and United States Companies at the contract price of 70 cents a night, which is probably satisfactory at the present cost of carbons. Incandescent lighting is also becoming quite common in the city, especially in new apartments and office buildings. It would doubtless be still more prevalent but for the practice of duplicating it with a gas system to be used in the case of an emergency. There appears to be no good reason for this, for although electricity may occasionally fail, more care would be exercised in giving it proper attention, if it was not understood that gas could be at once utilised in its place.

Electricity in the Royal Navy.—The ironclad *Bellerophon*, 14, which is shortly to be commissioned at Devonport Dockyard by Captain Charles C. P. Fitz-Gerald, now Captain of the Royal Naval College at Greenwich, is to be fitted with the electric light and torpedo fittings. Captain A. H. Markham, of the torpedo schoolship *Vernon*, at Portsmouth, has been directed by the Admiralty to proceed to Devonport for the purpose of consulting with the officers there as to the method of carrying out this work, which will, it is anticipated, be finished in time to admit of the ship being commissioned on December 14th. Orders have been received at Portsmouth Dockyard for the *Boadicea*, which was lately stationed at the Cape as commodore's ship, to be fitted with electric search lights.

Electric Lighting at a Leeds Bazaar.—For the benefit of a church at Leeds, the "Field of the Cloth of Gold" was set up at a bazaar there last week, and Mr. Bennett, acting for Messrs. S. F. Walker and Olliver, lighted the "military camps," eight in number, with incandescent lamps, worked from one of the firm's Gramme machines and a simplex gas engine of 2 H.P. No counter-shafting or other mechanical complications were employed, but Walker and Olliver's patent regulator reduced the effect of the blinking occasioned by the explosions in the engine.

Central Station Lighting in Boston.—From time to time during the past two years the question has been agitated whether or not the establishment of a central station for the distribution of incandescent lighting in Boston, U.S.A., would prove a profitable investment. A number of gentlemen prominently identified with electric light enterprises in New York and Boston have of late given the matter more earnest and careful attention than ever before, and have ascertained to their gratification that an institution of the kind referred to is wanted in the city, and is bound to meet popular approval and support. So encouraged are the promoters of the scheme that steps have already been taken toward the installation of a 5,000-light plant. A large building has been decided upon as suitable for the central station, and negotiations are to be immediately made for a long lease thereof. Engines have been ordered from the Armington and Sims Company, and arrangements consummated for a complete equipment of the plant. The incandescent system of the Edison Company will be used.

The Thomson-Houston Electric Light in Connecticut.—Mr. Charles H. Nettleton, of Ansonia, Conn., is installing a divided arc light plant of the Thomson-Houston system in the town of Shelton. This plant will supply lights for Ansonia, Birmingham, Shelton and Derby, the four towns being situated within an area of six square miles, and practically forming the town of Derby. At first only a 40-light dynamo will be put in; but as Mr. Nettleton has received assurances from a large number of manufacturers that his enterprise will receive their patronage, it is safe to predict that, to supply the demand for electric lights, both arc and incandescent, at least a half-dozen additional dynamos will have to be ordered.

Navigating the Suez Canal by the Electric Light.—In presence of the continued increase in the traffic through the Suez Canal, even during the present commercial crisis, and to provide for the still greater increase that is anticipated in consequence of the abolition of the pilot dues and the lowering of the tariffs, by which merchandise now reaching Europe from the East and from Australia by the route round the Cape will be able to be sent through the Canal, the company has for the last two years been making experiments with electric lights, with a view to enable vessels to continue their passage through the canal during the night. These experiments (says the Paris correspondent of the *Standard*) have at length proved so successful that it has been resolved to permit from the 1st of January next all vessels of war and postal steamers provided with the requisite electric lights to navigate by night that portion of the canal comprised between Port Said and kilometre fifty-four. Therefore, in almost half that portion of the canal where ships have to put into sidings to allow other vessels to pass them—in the Bitter Lakes vessels pass each other without stopping—vessels of war and mail boats, that together represent 22 per cent. of the total traffic, will be able to continue their passage at all times of the day and night. This will constitute a great saving of time, and M. De Lesseps in his circular expresses the confident hope that the trial will be so successful as to enable him to authorise, within a short time, night navigation for all descriptions of vessels through the whole length of the canal.

Electric Lighting in Chicago.—Electric lighting is to be rapidly extended over the north and west divisions of Chicago. Arrangements have been completed by which central plants will be extended over those districts at once, and the Dorsett conduits will be used by a new organisation which promises to do thorough and complete work over large areas of territory.

The Electric Lighting at Paddington Station.—A "shareholder of Great Western Railway stock" has written to the *Times* adding his protest to that of the residents in the neighbourhood, who recently made an application to the magistrate at Marylebone Police Court, against the nuisance caused by the electric lighting machinery at Paddington. This gentleman, however, must surely be in error, when he accuses a "colossal dynamo" of "vomiting huge clouds of steam and smoke." The writer concludes by remarking:—"It seems to be a sad, lamentable public scandal, as well as a culpable mismanagement of the funds of the shareholders of the company, for the Great Western Railway officials to erect costly heavy machinery on land unavailable for this purpose, and which must inevitably soon be removed by the company at the cost of the shareholders."

The National Telephone Company.—The fifth annual *conversazione* of the employés and friends of the Glasgow district of the above company, was held in the St. Andrew's Hall, on Friday evening, 13th inst. The assembly was a most successful one. In his address, the Chairman, W. A. Smith, Esq., drew attention to the extension of and improvements in the company's system throughout Scotland for the past year, by Mr. Bennett in the eastern districts, and by their own engineer, Mr. Sinclair, in the west. In those extensions and improvements in the telephone world, Glasgow had kept well to the front. Among the improvements he referred to their new switch-room in the Royal Exchange Buildings, into which they had introduced the most improved apparatus. Drawing attention to the difficulty that had been experienced in giving to the public the use of the telephone, without becoming subscribers, he mentioned that shortly the company would be in a position to do this by mechanical means, as Mr. Sinclair, along with another gentleman, had invented a very ingenious piece of apparatus whereby this could be done. He said he did not wish to trouble the meeting with statistics, but would just give a few figures, to convey an idea of the number of messages that had passed over the wires throughout their system. During the past week over 300,000 messages were sent, making a grand total of 16,000,000 for a year. Songs were artistically rendered during the evening by young ladies from the switch-rooms, and dancing was sustained with unflagging zest until an early hour in the morning.

Telephonic Experiments.—Mr. Wm. A. J. Kohrn, of San Francisco, writes to the New York *Electrician and Electrical Engineer*, as follows:—"In a communication recently published in the London ELECTRICAL REVIEW, the writer describes a number of experiments in relation to microphonic transmission of sound. In circuit with a carbon microphone and telephone receiver he placed an automatic transmitter, in which he used a ribbon of paper having a line of small holes close together, running longitudinally through the centre, similar to that used in the Wheatstone instrument. The 'automatic' was put in motion, allowing the current to pass through the microphone. The continuity of the circuit was continually broken, and words spoken directly to the carbon microphone without the intermedium of a diaphragm and without any substance whatever below the carbons were distinctly heard from the receiver, the articulation being as perfect as when the current was continuous. The writer has come to the conclusion that an undulatory current in a closed circuit is not necessary for telephonic transmission, and considers Bell's theory to the

contrary thus experimentally disproved. Having myself within the past two years conducted a series of experiments in the same direction, I am prompted to make a few remarks upon this subject; and while I thoroughly agree with the aforementioned correspondent, my investigations have enabled me to go a step farther. Not long ago a scientific paper published an article on the theory of the carbon microphone, in which are quoted the opinions of some of our most prominent electricians and scientists. All (with one or two exceptions) agree that variations of current passing through a carbon microphone are produced by pressure of the carbons against one another. Being a firm disbeliever in the variation of resistance theory, it is here that I differ. The statement that a certain theory is not necessarily true simply because it is backed up by a long list of scientific names, is one that cannot be ignored; and neither should 'accepted' theories always be relied upon, even though seemingly substantiated with proof. My theory of the action of a current in a battery transmitter is certainly a peculiar one. Briefly, it amounts to this: that the invisible electric current is *itself directly influenced* by the impacts of air affected by the voice, and that the microphonic contacts have *nothing whatever* to do with the transmission of speech in the sense of producing electrical undulations by variation of resistance in the circuit. In order to substantiate this theory, one of my first experiments consisted in affecting the current in a sufficient degree to deflect the needle of an ordinary detector galvanometer by producing sound upon a microphone (?) transmitter, the carbon 'contacts,' instead of being in direct electrical connection with each other, were, *fully one-eighth of an inch apart.* This may appear incredible but it is nevertheless true. Not only have I succeeded in producing a telephonic receiver without the use of either magnets, diaphragms, wire, or resonating cases of any sort, but also in transmitting articulate speech to considerable distances with a break in the conducting wire. At the conclusion of my investigations I hope to present to your readers a full account of these experiments in detail, and elucidate my theory in regard to the electrical transmission of sound."

Long Distance Telephony.—The Pacific Mutual Telegraph Company has lately strung a new No. 6 wire between Kansas City and St. Louis, and it is said to be the intention to continue this wire to Chicago at an early day. The section just completed was tested by the long distance telephoning recently. Messrs. Meyers, McDaniel, Crandall, Burrett, and other local electricians were in attendance at the Kansas City end, and the officers of the telephone and telegraph companies at the St. Louis end. Mr. Meyers, superintendent of the Pacific Mutual, gives the length of this wire at 320 miles, and all present testified to the clearness of the signals, and the ease with which they could distinguish their friends' voices at the other end. There chanced to be a thunder-storm at the time, and this in a measure interfered with the experiment. It also interfered with the amusement of some of the party. Mr. Crandall happened to have the telephone to his ear when a flash of lightning came in on the wire, and the shock he received caused him to drop the instrument without any premeditation and retire to the other side of the counter. During the rest of the exercises he was simply an attentive observer—at a distance.

A Retrograde Movement.—It is devoutly to be hoped that the example set by the telephone subscribers of Concord, Mass., as told by the *Monitor* of that city, will not be widely followed. The paper states:—"The removal of telephones continues as fast as the men can take care of the instruments, the number thus far taken out being 124. This leaves 103 still in use, and the lessees of 25 of those are signers of the remonstrance. Of the remaining 78 probably 30 will be ordered out on the first of November, leaving less than 50 controlled by this exchange. It is hardly probable that the exchange will run for so small a number of patrons, and unless some arrangement is made in the meanwhile, it will not be surprising if it is permanently closed. The decline of the telephone in this city is even more sudden than its rise. The exchange was first opened here in May, 1881, at which time there were but 13 instruments in use. It grew rapidly in favour until a total of 227 instruments was reached, and the prospects were good for a still further increase at the time of the advance of rentals, and consequent trouble."

Telephonic Communication at Sandringham.—A very comprehensive system of telephonic intercommunication has just been completed at Sandringham for H.R.H. the Prince of Wales. An entire absence of induction effects was particularly insisted upon, and this has been very successfully accomplished by the use of specially manufactured cables, and which are laid underground in pipes. Eleven of these cables are taken from a switch-board in Sandringham House to various parts of the estate, including the residence of Major-General Sir Dighton Probyn, the equerries' cottages, the agent's house, and the railway station at Wolferton. Messrs. Tasker, Sons and Co., of Sheffield, telephone engineers to Her Majesty, have carried out the work, using their usual telephonic combination of Johnson and Bell patents, and the clearness of articulation and the rapidity with which intercommunication can be established are very prominent features of the undertaking. At the conclusion of the work, and when the possibilities of the system had been thoroughly proved, Mr. Johnson had the honour of an interview with H.R.H. the Prince of Wales, and to him His Royal Highness expressed in gratifying terms his satisfaction at the marked success of the installation.

Funeral of a Telegraphist.—Mr. W. C. Ridgley, of the Southampton Postal Telegraph Department, with which he had been connected for many years, died a few days since near Southampton, and his funeral took place at Shirley. The funeral *cortége* included Mr. A. V. Tubb, Superintendent of the Telegraph Department; Mr. A. Oakshott, Assistant Superintendent; and many others. Deceased, who had been attending to his duties only a fortnight prior to his demise, was greatly respected.

Proficient Military Telegraphists.—The result of a recent examination of the telegraph or signal party of the 1st Hants Artillery Volunteers has been reported, and it appears that the following have gained the badge:—Staff-Serjeant Burniston, Corporal G. Wells, Private McKenzie, Private Anderson, Lance-Corporal Walker, and Private Weavett. Company prizes for signalling have also been awarded to Serjeant Burniston and Corporal Wells.

Telegraphic Facilities.—The following has been made public during the past week:—It may be useful to the public to be reminded of facilities at their command with regard to telegrams, which although described in the Post Office Guide, do not appear to be widely known. The sender of a telegram who desires to have his name or any instructions, such as "private," "confidential," "to be opened," or the like, written on the outside of the envelope of the message, may write the necessary instructions, which must be paid for as part of the message, immediately after the address of the receiver. Persons not wishing to send to a telegraph office may post a telegram in an envelope addressed, "Telegram, immediate," in a wall or pillar-box, or at a receiving office or sub post office. Telegrams so posted are sent on by the next collection to the nearest telegraph office, are thence transmitted, and are delivered free of extra charge, provided the proper amounts for transmission and for porterage (if any) have been prepaid by stamps affixed to the telegram. Telegrams may also be posted not enclosed in envelopes, and when so posted they will be treated in the same manner. Telegrams may be handed to rural postmen on their way to telegraphic offices.

The Fighting in Bulgaria.—Scant intelligence of an independent character of the war between Servia and Bulgaria may be expected through Servian channels. The Ministry of Commerce at Belgrade has forbidden the telegraph officials to accept foreign war telegrams.

Telegraphy in Canada.—The construction of the new sections of the Government telegraph line in the North-West Territories of Canada is being rapidly proceeded with. The Moose Jaw and Wood Mountain section, 93 miles in length, has just been finished, and arrangements are being made for the immediate construction of the line from Battleford to the place to be selected for the new centre in the Pitt district. The work is to be let in short sections of probably 10 miles each, no one but residents along the line being allowed to tender. A line is also, it is said, to be constructed from Edmonton to Victoria, and next year the gap between Pitt and Victoria will be closed.

Telegraph Revenue.—The receipts on the telegraph service from April 1st to November 14th, 1885, amounted to £145,000 against £150,000 from April 1st to November 15th last year.

A Curious Accident.—A rather singular incident occurred on the Caledonian Railway, near Bishopton Station, on Thursday week. When a train from Glasgow was approaching the station, one of the telegraph wires suddenly snapped and struck with great force against the side of the carriages, breaking the whole of the glass in half-a-dozen first-class compartments, and causing the greatest excitement and consternation amongst the passengers, who were numerous. Some of the glass struck a young lady on the face and caused a slight cut on her forehead.

Mr. Pender and the Port Hamilton Cable.—Mr. Pender has established for himself a name as a diplomatist and a good business man, but does he really mean us to understand that he has succeeded in foisting upon the Government a cable which is 15 years old, and which has required "frequent and costly repairs," for communication with Port Hamilton? That would seem to be the inference to be drawn from his remarks to the shareholders of the Eastern Extension Company last week, although the statement is not quite positive. Readers who are interested in the subject will find Mr. Pender's remarks respecting the use to which old cables are put in about the middle of the first column on page 421 in last week's REVIEW. It is instructive to note that the Port Hamilton cable has broken since it was laid.

Persian Gulf Cables.—The cable steamers *Dacia* and *International* were both at Jask (Persian Gulf) on the 14th inst., and the laying of the new Persian Gulf cable was commenced on the following day.

Atlantic Cable Rates.—It is confidently stated that at a conference of representatives of Atlantic cable companies, a resolution has been adopted to raise the rates for the transmission of messages. The Commercial Cable Company is said to have joined in the arrangement.

Navigable Balloons.—According to the *Standard* correspondent at New York, General Thayer, who has exhibited before the members of the Military Service Institution, a working model of a navigable balloon, at the same time described a plan for moving by electricity balloons attached to ordinary telegraph wires fixed to poles. To these balloons a velocity of seventy miles could be given, according to the inventor.

Contracts Open.—For lighting by electricity the seven shops and premises now in course of erection in Fore Street, Redruth, to which matter we referred in our last issue, Mr. J. Hicks, Redruth, is architect.

Coal Consumption on the Elevated Railways.—Mr. Charles G. Curtis, writing to the New York *Electrician and Electrical Engineer*, refers to an account in the *Car Builder* for July, that some tests of the locomotives on the Third Avenue elevated railroad were made by Mr. Angus Sinclair, to ascertain their actual horse-power and coal consumption, and continues:—"The indicator cards taken by him showed them to exert an average of 77·8 H.P., and to consume an average of 5·8 lbs. of coal an hour per H.P. I refer to it here because it is so satisfactory a verification of the results arrived at by a theoretical mechanical calculation, taking into account the stops, and agrees so closely with the results of such a calculation which I gave in the *Electrician and Electrical Engineer* for May, in which the power came out at 75 H.P., and the average coal consumption 6·6 lbs. an hour per H.P. The results of 5·8 lbs. of coal, which is even less than I made it, is surprisingly low, and shows how little margin there is between the performance of these locomotives and that of stationary engines to make up for the losses that must necessarily occur in transmitting the power by electricity. If anyone can take the elevated railroads and operate the trains by electricity generated by stationary steam engines, so as to obtain each H.P. on the track with less or materially less than 5·8 lbs. of coal per hour, I for one electrician would like to know how it can be done."

Underground Wires in Philadelphia.—The Pennsylvania Legislature has defeated the Bill making underground wires compulsory, so that the local ordinance of Philadelphia, directing the placing of wires underground, becomes a dead letter.

A "Palace of Delight."—As a memorial to the late Sir Titus Salt, and in recognition of his benefactions to Saltaire, the Governors of the Salt Schools have decided to build a new Science and Art School, costing about £6,000. The building will be completely finished by May 15th, on which day will be opened an important exhibition on the lines of the late International Inventions Exhibition. For this purpose the present buildings and a field of six acres will be utilised; the whole being named the "Palace of Delight," in allusion to the ideal institution delineated in Mr. Walter Besant's "All sorts and conditions of men." Accommodation will be provided for over 10,000 people, and the affair will be the largest of the kind ever seen in the provinces, the probable outlay being over £15,000. With the object of attaining the utmost excellence, space will be allotted only to the most eminent firms in every conceivable branch of industry. Amongst other exhibits will be the South Kensington Collection, and the Prince of Wales's Indian Collection. The grounds already alluded to will be planted and illuminated with the electric light, having fountains similar to those at the Inventions Exhibition, illuminated with coloured electric lights. In view of the variable climate, an enormous tent of the American description will be put up in the grounds, capable of holding several thousand people. The arrangement and supervision of the lighting, and other electrical work, including the contract of the installation and maintenance of the electric light in the buildings and grounds, have been entrusted to Messrs. Woodhouse and Rawson.

The Electrical Transmission of Power.—M. Hospitalier is rather severe on Marcel Deprez's recent experiments, but not unreasonably so. He says that a costly plant destined to transmit 100 horse-power from Creil to Paris, permits the transport of 40 horse-power from Creil——to Creil.

Torpedo Boats.—Now that Mr. Nordenfelt has been actually successful in producing a submarine boat which can be propelled under water for some hours, we should imagine that this subject would offer a capital field for the employment of secondary batteries.

Underground Wires in New York.—The New York *Evening Post* of October 21, published an editorial on the underground wire problem, in which a solution of the problem of burying the wires was offered. Along Broadway, just outside the curb line of the street, there was to be constructed a capacious underground gallery, wherein all the present impedimenta might be placed, and any obstruction which the workmen might encounter in the building of this gallery was to be removed. Herein were to be placed the steam, gas, sewer, pneumatic, hydraulic, and various other pipes, in addition to the wires of the various electric companies. The other streets of the city were to be tunnelled on a similar though less elaborate plan. *Science* commenting upon this suggestion remarks :—"Magnificent as this plan may seem, it is hardly an exaggeration of what the underground commission actually proposes to require. They have caused it to be understood that they will consider no plan of placing the wires underground which does not combine all kinds of wires in a single conduit, with an arrangement by which access to every house may be obtained without excavation of the street. The question that interests the various electrical companies is, 'Who is to undertake this extensive piece of engineering, and who is to pay for it?' Certainly, the commission has no power to construct such conduits, and, even if it had, it is difficult to see how the various electrical companies could be compelled to make use of them, or to pay for such use. That it is not only technically possible but economically practicable, to put the large mass of city wires underground, was admitted by the electrician of the American Bell Telephone Company, Dr. W. W. Jacques, in an article published in *Science* of July 3 of the present year, and the Metropolitan Telephone Company, whose mileage of wire in New York City is greater than that of any other company, has actually asked permission of the commission to put a part of its wires underground, and such permission has been refused. The reason why the wires in New York are not placed underground, and why they are not likely to be placed underground at present, is, not that it is technically impossible, and not that the parties operating them do not desire to place them underground, but because the commission insists upon its being done in accordance with an entirely impracticable plan."

Hydro-Electric Meters.—M. Gerboz writes to us to the effect that he is pleased with Mr. Kent's letter in our last issue, but that he thinks this gentleman has not quite understood the apparatus illustrated in the REVIEW for the 31st ult. Our correspondent says :—"In our patent we write that it is easy to get the valve of such a form that the sectional area of the 'orifice' should be proportional to the vertical displacement of the valve, this displacement being itself practically proportional to the number of amperes. It is one of the reasons why we have used the cylindrical shaped electro-magnet. Thus it would be easy to use one wire not only for one lamp, but for a series of lamps. If you prefer it, you can have any valves of which the orifices should be proportional to the number of ampères required by the lamps used in each circuit ; the resistance of the electro-magnets being arranged for each kind of lamp." M. Gerboz further remarks :—"I do not know whether Mr. Kent's counter is working, but ours is doing so."

Respecting the "hydro-electric meter" described in our last week's number, Mr. G. A. Nussbaum writes that he had the same idea some time ago, and communicated it to some of his friends, but he gave it up because he found that Mr. Lane-Fox had substantially anticipated him.

"Struck Ile!"—The Local Board of Hayward's Heath, not being able to agree with the local gas company, has resolved to revert to oil for the public lamps, and has arranged for the erection of 40 lamps, and a supply of Royal Daylight Petroleum at 7⅗d. per gallon.

The Siemens Memorial Window.—It was announced by Sir Frederick Bramwell at the last meeting of the Institution of Civil Engineers, that the ceremony of unveiling the Siemens Memorial Window, in the nave on the north side of Westminster Abbey, was to take place on Thursday, November 26th, at 2 p.m., that day being the second anniversary of the funeral service in the Abbey.

Gasmaking a Nuisance.—An indignation meeting of ratepayers has been held at Belfast, at which complaints were made that the Corporation, against whom an Order had been obtained for the abatement of a nuisance at the gas works, had done nothing to mitigate it. It was asserted that both health and property were being injured by the emanations from the works, that Belfast foul lime was very much worse than the London lime, that Belfast was twenty years behind London in the matter of gas purification, and that one thousand tons of foul lime certainly polluted an area of several square miles.

The Value of Incandescent Lamps.—It will be remembered that the Franklin Institute recently carried out a series of comparative trials of incandescent lamps. Referring to this subject, the *Engineer* says it is to be regretted that the investigation was carried out under conditions which have deprived it of value. This is the opinion of competent electricians in this country, and was admitted at the last meeting of the Dynamicables. Our contemporary remarks that in dealing with the question of the value of incandescent lamps, it is above all things necessary to be quite clear and precise in the use of terms. A great deal of vague talk circulates concerning the lighting power and the longevity of incandescent lamps ; and the general public may rest certain that they do not hear quite the worst. Putting this on one side, however, no one really knows, except by chance, how much light an incandescent lamp gives with any accuracy. Light cannot be measured or weighed like milk or beef, and the consumer is compelled to trust to the good faith of the electrician to get what he bargained for. In the case of gas it is different. The gas is tested by examiners, and when the consumer is told that he is supplied with 16-candle gas he knows that he has a Government guarantee that he gets gas of a definite quality—that, in a word, he has what the company sold to him. The testing of incandescent lamps is a far more difficult matter than the testing of gas, and the work has not yet been brought to anything like perfection. Furthermore, there is a very great difference in the amount of light given out by an incandescent lamp in various planes vertical and horizontal. Do the makers always measure them in the worst or the best position? Who will say? Leaving the question of amount of light developed by a given power on one side, let us turn to the question of longevity. On this point again very vague ideas prevail. Curiously enough, the condition of the lamp at any given epoch is overlooked. But incandescent lamps are, like human beings, liable to decrepitude in old age ; and, just as the most decrepit men and women seem to possess charmed lives, so it is with the aged incandescent lamp. The feeble old man of ninety takes care of himself ; he runs no risks. The incandescent lamp of two or three thousand hours follows this good example ; it takes care of itself. It may be the worst possible economy to use long-lived lamps. Indeed, so far as is known, there seems to be a particular period in the lives of some incandescent lamps which, once reached, they ought to be superannuated ; but no one yet knows what is the precise period. In conclusion, our contemporary points out that there is no such thing as a good volt or ampère meter to be had in the open market. A mathematical instrument maker can send his thermometers and barometers to Kew and get them tested for a small charge. The watchmaker can do the same thing by his chronometers and watches. The pound weight and the yard measure can be verified by Government standards ; but there is nothing of the kind available in a general way to electricians, and it is

quite time that there was. At present, as far as incandescent lamps are concerned, at all events, there is no trustworthy evidence to be had as to what their powers really are. Electricians are in the position of the earlier inhabitants of this island, who, lacking foot-rules, measured lengths in terms of grains of corn.

Railway Carriage Lighting.—In an article discussing various methods of illuminating railway carriages, and advocating an improvement upon present practice, the *Times* says :—"Another system, the merits of which have been discussed, is that of electric lighting. But in the discussion the fact has been lost sight of that what has been done in the way of lighting railway carriages by electricity has been effected in the main at the expense of the patentees or their representatives, without the pockets of railway shareholders being in the least degree affected. Of the schemes which have been brought before railway managers and engineers for lighting trains by electricity, it may be said that their name is legion. But, notwithstanding this, there appear to be only about six trains running at the present moment which are lighted in this way, while some four others have been standing still for such a long time that the suspicion is gaining ground that the carriage superintendent has decided after trial to take off the fittings. The electric lighting of trains would appear to be in pretty much the same condition as the electric lighting of streets and buildings. Sometimes one system is tried and sometimes another, but nothing is definitely adopted and settled. Looking round generally, it appears as though—the Paddington experiment excepted—there is less electric lighting to be seen than there was two years ago."

Theatre Lighting.—One evening last week we were invited to inspect the electric lighting of Covent Garden Theatre, and, under the direction of Mr. Reginald Newington, the engineer to the Jablohckoff Company, were enabled to examine into all matters connected therewith. One must have been hard to please to find fault either with the light of the Jablochkoff candles or with the incandescent lamps employed therewith. Two of Hornsby's engines supply the motive power to five alternating Gramme machines, and the whole plant is well laid down, advantage being taken of every inch of the limited space at command. The entire system, notwithstanding the fact that accumulators cannot be used, appears to be well adapted for theatre lighting, and during the whole Promenade Concert season but little has occurred upon which to base any serious objections thereto.

United Telephone Company.—We see in the Law Notices that a case, "United Telephone Company *v.* Tasker Sons & Co.," is shortly to come before Vice-Chancellor Bacon. Is there more patent litigation looming in the near future ?

Is Electrical Property Improving ? — Thursday's *Daily Telegraph* announced that "electric lighting shares, telephones, Anglo-American Telegraphs . . . . . were also in demand, and generally higher."

A Swindler.—At Southwark Police Court on Wednesday, William Wilson, 32, who described himself as an electric engineer, was charged with fraudulently obtaining various sums of money from a number of young men out of employment, by pretending to be able to obtain situations for them in "the" Electric Light Company.—Mr. A. Lewis prosecuted for the Treasury, and the Court was crowded by young men who, it was stated, had been victimised by the Prisoner. —Mr. Lewis said there were at least fifty charges against the Prisoner, who had been picked out that morning by the victims among twenty men in the yard of the Court. He did not propose to call all those persons, but five cases which occurred in the district of the Court had been selected to send the Prisoner for trial.—William Jackson, a groom out of work, stated the circumstances under which he had been deceived into handing 15s. to the Prisoner, and four other witnesses having given similar evidence, the Prisoner was remanded for a week.

NEW COMPANY REGISTERED.

Fischer Electro-Amalgamator Company, Limited.—Capital £25,000 in £5 shares. Objects :—To purchase the letters patent, No. 5834, dated 10th November, 1884, granted to Ewald Fischer and Max Wm. Weber, for improvements in extracting gold and other metals by amalgamation, and apparatus therefor. The purchase consideration is £7,500 cash and £7,500 in fully paid shares. Signatories (with one share each) :—Arthur John Rhodes, Oakdene, Beckenham ; Capt. G. P. Heine, Waltham Cross ; Max Wm. Weber, 69, Darville Road, Stoke Newington ; H. Julius, 36, The Avenue, Tottenham ; L. J. Langmead, 117, Upland Road, Surrey ; O. J. Perkins, 24, Horsford Road, Brixton Rise ; S. Bodascher, 2, Trelawney Road, Brixton Rise. The signatories are to appoint the first directors. Registered 13th inst. by Messrs. Irvine and Hodges, 79, Mark Lane.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES

Maxim-Weston Electric Company, Limited.—By a special resolution of this company, passed at a meeting held in May, 1883, the directors were empowered to allot any part of the unissued capital of the company either at a premium or discount, at their discretion. Acting under this authority, an agreement has been entered into (dated 9th inst.) under which the company will issue 50,000 shares for 5s. per share, such shares to be allotted as fully paid up, and to rank for dividend with the shares already issued.

Consolidated Telephone Construction and Maintenance Company, Limited.—The annual return of this company, made up to the 9th June, was filed on the 16th inst. The nominal capital is £243,787 10s., divided into 224,850 shares of 15s. each, and 75,150 shares of £1 each. The whole of the 15s. shares have been taken up and are fully paid, the remaining shares being at present unissued. Since the last return the capital of the company has been reduced from £300,000 in £1 shares.

Chelsea Electricity Supply Company, Limited.—The registered office of this company is now situated at Draycott Place, Cadogan Street, Chelsea.

Woodhouse and Rawson Electric Manufacturing Company, Limited.—At an extraordinary general meeting of the members of this company held at 11, Queen Victoria Street, on the 20th ult., it was resolved that an agreement, to be dated 3rd November, 1885, between Otway Edward Woodhouse and F. Lawrence Rawson, to be supplemental to the purchase agreement referred to in article 65 of the articles of association, shall be duly carried into effect. This resolution was confirmed on the 3rd inst. and registered 10th inst.

New Electro Amalgamator Company, Limited.—Under an agreement of the 1st inst., filed on the 12th inst., between this company and the Electro Amalgamator Company, it is agreed to issue 777 fully-paid shares to various creditors in discharge of their respective claims.

CITY NOTES, REPORTS, MEETINGS, &c.

West India and Panama Telegraph Company, Limited.

THE seventeenth ordinary general meeting of this company was held at the Cannon Street Hotel, on Wednesday, under the presidency of Mr. C. W. Earle.

The Secretary, Mr. R. T. Brown, having read the notice convening the meeting,

The Chairman said the report (which appeared in the REVIEW last week) was the shortest the company had ever issued, the reason being that there had been very little of an eventful nature during the half-year, and the accounts themselves practically told the whole of the story. The balance of the revenue over expenditure was almost the best they had ever had, being £1,190 in excess of that of the corresponding half of the previous year; it was the best half-year, with the exception of one previous instance in 1878, when it was about £1,000 better than now in consequence of several windfalls, they had had to report upon. Upon the expenditure side there was nothing special to mention, the amounts of the different items being very much the same as they always were. He had received a letter from one shareholder remarking upon the expenses of the ship in harbour. He presumed that gentleman thought these ships were left in harbour in the same way as colliers were laid up. The fact was that, whether the ships were in harbour or at sea, the difference of expense was very trifling, the only difference being the cost of coal while steaming. All the technical people, the electricians, the engineers, the jointers, and the officers, were always on board, and, like a man of war, the vessels were always ready to go where they were wanted. He might tell them that he was a great stickler for economy, and perhaps some would call him a screw. When spending the shareholders' money he felt he ought to be a screw. But concerning the expenditure he thought they could justify themselves to the utmost. The traffic returns, although they had been good during the first-half of the year, now, he was sorry to say, showed a decrease of about 10½ per cent. Still, having in view the great commercial depression which pervaded the world, and which was particularly severely felt in the West Indies, he thought the wonder was the company had not sooner felt it. He hoped for better times for all countries, and certainly revival of trade would benefit them. He mentioned last time he addressed them that a rise had taken place in the price of sugar; but since then there had been very little advance. After all, however, the fluctuation in the traffic receipts had not so much to do with their prosperity as the repairs they had to execute. If they had a light season in repairing, the returns showed a great improvement. The cables were giving them less trouble than they did, and there was now comparative freedom from interruptions. The cable he told them had been repaired a year ago—the original Jamaica-Porto Rico cable—had not given them any trouble. That cable, until it was repaired, remained inoperative for ten years. It was an important section, 700 miles in length, and 232 miles of new cable had been put in. It had worked very satisfactorily, and during the time the other cable was interrupted, maintained communication with the West Indies, when otherwise it would have been cut off. They anticipated a heavy job in repairing the Jamaica-Santiago cable, which had been inoperative almost as long as the Jamaica-Porto Rico cable. In 1878, a duplicate cable was laid, and it had worked very well. The depth of the water where the cable lay, was 3,000 fathoms, and, hitherto, they had been unable to lift the whole cable. It was dangerously near the other cable, only about six miles separating the two, and they would see the difficulty of lowering a grapnel four miles into the sea and attempting to recover a cable without any bearings to guide them—for it was out of sight of land. The *Grappler* was coming home, and they would shortly have the benefit of the captain's assistance; and he (the Chairman) hoped that, before meeting the shareholders again, the cable would be put into order. No doubt they would have to abandon portions of the cable, but it was impossible to say how much new would be required; the section was 150 miles long, and a considerable amount of cable would undoubtedly be required to properly repair it. As long as the West Indian trade remained in its present low position, they could not expect any increase in the revenue, and they certainly could not expect any increase of the subsidies, seeing the depressed state the colonies were in. If they could only get their cables to be more durable, and save expenditure in that way, they would have a more prosperous career. He begged to move:—"That the directors' report and accounts to the 30th June, 1885, submitted to this meeting be and the same are hereby received and adopted, and that, as recommended by the board, a payment of 9s. per share on account of arrears of dividends on First Preference shares be and the same hereby is declared."

Mr. W. Ford seconded the resolution.

Mr. Guesdon congratulated the shareholders upon the satisfactory position to which the company had attained, and upon the firmness the directors had shown in building up a reserve fund, which was a point of the highest importance in all cable companies, and particularly so in this one. He also congratulated the directors upon the nature of their investments, and then proceeded to criticise their policy with respect to the insurance of their ships and other matters. He advocated the insurance of the ships amongst the shareholders, but not to their full value. At present they were insured at nearly one-third more than their presumable worth in the market.

Mr. Andrews: It is not a question of their value in the market, but of what we can replace them at.

Mr. Guesdon said they could not value their old ships at the price of a new one. He merely threw out the question for the consideration of the board as to whether, with a large depreciation going on, it was sound policy to insure to the full value. He then proceeded to advocate a reduction in the directors' fees, and also in the number of directors.

Mr. Horner reminded Mr. Guesdon that the directors took office under certain conditions, and the question of fees had been thrashed out over and over again.

The Chairman said, with reference to insurance, they paid between 6 and 7 guineas per cent., but they would consider the question Mr. Guesdon had put before them. In his scheme, however, there was one thing which would not commend itself to the shareholders, and that was that there would be no protection in the case of collision. As to fees, they were called into office at a critical moment, when the company was almost in bankruptcy. Certain terms were held out to them, and they accepted them. He was always willing to give up his seat, but so long as the directors remained upon the board they would take their fees. Mr. Guesdon raised the matter in 1881, and when the circumstances were explained to him, he desired his remarks to be expunged.

Mr. Veares spoke for some time in terms which excited the risible faculties of many of the shareholders, the tenour of his remarks being that it was time to do something for the ordinary shareholders.

Mr. Griffiths enquired if the directors could state when the reserve fund would reach a sum which would ensure the safety of the company, and relieve them from the necessity of adding large sums to it every half-year.

The Chairman replied that the reserve fund was, properly speaking, a depreciation fund, providing for a depreciation which went on from year to year, and which they had to meet, so that he could not hold out any hope that they would cease adding to it. They were, when the board took office, very much behindhand with the reserve fund, and this had necessitated larger additions each half-year than would be required in future, so that they might anticipate some relief in that respect.

A Shareholder asked for information as to the probability of a payment on the ordinary shares.

The Chairman said their first duty was to the preference shareholders, and they had now made one step toward lessening their indebtedness to them. If repairs were not largely needed, no doubt the company would make more rapid progress in paying off that *quasi* liability. Until that was done he saw no way of benefitting the ordinary shareholders.

Mr. Robinson Kendal hoped the board would not listen to the nonsense talked about insurance, which was at all times a delicate, difficult, and hazardous matter, and particularly so in regard to cable steamers. He hoped their vessels would be kept insured in very good offices, and up to the full amount, and that the directors would not for one moment entertain any question of dealing in the way suggested with the matter of insurance.

The resolution was then put to the meeting, and carried.

Mr. Guesdon moved a vote of thanks to the chairman, which was heartily accorded, the proceedings thereupon terminating.

TRAFFIC RECEIPTS.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th November, are £1,827, as compared with £2,170 in the corresponding period of 1884.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph-Engineers and Electricians.

AN ordinary general meeting of this society was held on Thursday, November 12th, Mr. C. E. SPAGNOLETTI, president, in the chair. The minutes of the last ordinary general meeting having been read and confirmed, and the list of new and proposed new members announced, a paper was read by Major-General WEBBER, C.B., R.E., past president of the society, on "The Telegraphs of the Nile Expedition."

The author commenced his paper by stating that in 1883 he had read before the society a paper descriptive of military telegraph work carried out during the Egyptian Expedition of 1882. The telegraph system as carried on by the Egyptian Government was totally inadequate to cope with military necessities; the lines were in a very defective state, the poles being decayed, whilst faults were continual and of long duration. He had found batteries which had not been looked at or cleaned for a period of 17 months. The use of the earth wire for terminating a circuit at an intermediate station was common, and was most objectionable. The whole of the circuits, he would mention, were led into the Khedive's palace, so that all the message work could be controlled by the officials there. The experience of the system and its working gained at that time in Lower Egypt was of some service when operations on a far more extended scale had to be undertaken in Upper Egypt and in the Soudan. For the former province, which extends telegraphically from Cairo to Wady Halfa, where Gordon had drawn the boundary line in 1878, the system was worked and maintained under the Egyptian Railway and Telegraph Administration. For this section of the line of communications, over 700 miles long, the "through" wire was lent to the Army in the same way that wires in this country were hired to private persons. But the Army continued to allow commercial and Governmental telegrams in Arabic and European languages to pass over it, subject to military control. South of Wady Halfa, where the Soudan

system began, all the lines and offices with the native clerks and maintenance staff were taken possession of by the Army Telegraph Department by a direct agreement between the Soudan Bureau, as representing the Egyptian Government and the British Army. The maintenance of the lines and offices and the absence of a good system of control and direction of the Egyptian telegraphs resulted in constant interruptions, the aggregate time of which amounted to 40 days in six months. Results of careful tests of the line by Captain C. K. Wood, R.E., showed that on one section the total insulation of the line often fell as low as 5,000 ohms, the conductivity varying from 1,350 to 3,400 ohms. The currents received on the relays were as low as from 1 to 4 milliampères. Owing to frequent breakdowns of the line between Assiout and Cairo, Lord Wolseley, had on more than one occasion to send instructions to Colonel Lloyd, the commandant at Assiout, to forward important telegrams by special engine. To occupy in succession the whole of the offices between Cairo and Merawi with efficient clerks and apparatus, to effect urgent repairs on the line, to lay cables across the Nile when required, to open new offices, and to get the circuit "Cairo to Korti" into thorough working order, occupied a period of three months, October to December, inclusive, owing to the enormous distance to be traversed, and the extreme scarcity of all transport south of Wady Halfa. This work was done by six officers and over 120 non-commissioned officers of the Royal Engineers Telegraph Battalion, assisted by the native Arabic staff. A circuit with nine stations in it, at three of which translation was used, was safely worked from about the 1st of January to the end of April. Branch lines on the east bank, on the railways between Assouan and Shelal and between Halfa and Savoi, were put up with extensions to Semneh Magrat, Ambukol, and Akasha. An efficient service was maintained day and night for many months. Over 50,000 telegrams in English passed over the lines, besides 6,000 or 7,000 in Arabic. The General of Communications, Sir Evelyn Wood, forwarded over 3,000 telegrams written with his own hand. The lines were used freely besides for purposes of conversation between the Commander-in-chief, the generals, and the staff. Major-General Webber himself conversed almost nightly with one or other of the members of the telegraph service in organising and directing the working of the system. It required about 38 highly-trained telegraph clerks, some of whom were Post-Office volunteers, to keep the service going on the main line alone. As the Egyptian Administration had not more than two clerks in its whole service equal to such high-class work, which included reading English words and cypher symbols by sound under exceptional difficulties, it would have been absolutely impossible for it to render the Army a service of such a nature. The author said that, after the human energy and the energy of the north wind which aided the expedition in its advance up the Nile, the result of the expedition, so far as the arrival of the Army at Korti in the time was concerned, was due to the work done with electrical energy as its motive power. All orders, instructions, answers, and replies arising out of the ever-growing demands and unexpected complications of such a vast undertaking were forwarded and received by telegraph. Just as with the telegraphs at home, as long as there was no trouble there was no complaint; similarly, the more smoothly the expedition telegraph worked, the less the Army and the public at home, who were served by it, thought about it. This unconsciousness of its work and want of official recognition of the results was the highest praise in the eyes of telegraphists that could be given to its efficiency. But the public at home had not forgotten the Press telegrams, the last words of which often only left the Korti office at 6 a.m. to appear in the columns of their papers that morning; and those present would perhaps join in hearty praise of the efficiency, discretion, and self-denying work, under every conceivable adverse conditions, of every member of the telegraph battalion with the expedition. The author explained the cause of the absence of rapid communication between Korti and Metammeh, and the great use to which the heliograph could have been put in the Soudan. He deplored the arrangement in our Army by which signalling and telegraphy, both the offspring of the same object, had been divorced; and he expressed a strong hope that, although he could never expect again to be similarly engaged, some one of those officers who had gained experience in the late expedition would find himself some day engaged in directing a combined organisation of telegraphy and signalling, by which a *maximum* of result would be obtained from the means in use. He referred to the cordial working between the Army Telegraphs and the Eastern Telegraph Company, and to the gratitude of the Army expressed for their liberality and that of Reuter as regards private messages and bulletins of news. He ascribed the successful results attained to the admirable training of which the officers and men of the Royal Engineers in the telegraph battalions had been the object since 1870, in and out of the Postal Telegraph Service; to the discipline, discretion, and loyalty to their directors of all ranks; and to the inspiriting effect on the telegraph service generally of the need to strain every nerve to help to bring about the accomplishment of the objects of the expedition. He showed how, gradually, during peace, and in face of many difficulties and much opposition, a good organisation of the Army Telegraphs had been arrived at, the proof of which, he might say, lay in their unexampled success in the late expedition, when the Army had been served in a way that had never before been accomplished by telegraph in any British war.

General WEBBER spoke warmly in praise of the services rendered by Major Bennet, Capt. Wood, and Major Bagnold.

In the discussion which followed the reading of the paper,

Mr. OATEWAY, of the General Post Office, stated that the cost of the Press messages sent through the Soudan line of telegraph was £12,000, and that the total value of messages sent through the line was £64,362. Throughout the whole campaign there had been only one complaint of delay on the part of the Press, and he believed that that had been made rather against the Eastern Telegraph Company than against the military telegraphists.

Col. HARRISON, Capt. BERESFORD, Capt. HAMIL, R.N., Major JELF, Prof. FORBES and Col. HAMILTON, also took part in the discussion.

The meeting then adjourned.

Physical Society, November 14th, 1885.

Prof. GUTHRIE, President, in the Chair.

Mr. G. M. WHIPPLE described and demonstrated experimentally the process of testing thermometers at and near the melting point of mercury, as carried on at Kew. About twenty pounds of mercury was poured into a wooden bowl, and frozen by carbonic-acid, snow and ether, the mercury is stirred with a wooden stirrer, and the snow is added till the experimenter feels by the resistance to stirring that the mercury is freezing. The stirring is continued for some time, which causes the mercury to become granular instead of a solid mass. The thermometers are then inserted, together with a standard, and compared. About 100 mercury, or 40 spirit thermometers can be thus examined in half-an-hour, using about 200 gallons of carbonic-acid gas, compressed sufficiently to form the snow. The bowl, ether, and mercury, are cooled first to 10° C. by an ordinary freezing mixture. The average correction at the melting point of mercury is now less than 1° Fahr.; when the process was introduced in 1872 it amounted to 5° but has steadily decreased.

"On the electromotive force of certain tin cells," by Mr. E. J. HERROUN. Mr. Herroun has examined the electromotive forces of cells in which tin, in a solution of its salts was opposed to copper, cadmium and zinc, in solutions of their corresponding salts, the solutions being of equal molecular strengths. The salts used were sulphates, chlorides and iodides, and the cells were of the ordinary "Daniell" form, with a porous vessel. To prevent the formation of basic salts, it was necessary to add a little free acid to the solution of the tin salt, and to counterbalance the influence of this acid upon the E.M.F., as far as possible, an equal proportion of free acid was added to the other solution.

Prof. G. MINCHIN pointed out the importance of performing these and similar experiments upon tin in the dark, as by allowing light to fall upon the tin plate a considerable photo-electric effect would be obtained.

Prof. FLEMING insisted upon the great importance of temperature corrections in all experiments upon two fluid cells.

"On the law of the electromagnet and the law of the dynamo," by Prof. S. P. THOMPSON. It cannot be said, up to now, that any particular law has been generally accepted giving the relation between the current in the coils of an electro-magnet and the magnetism induced by it in the core. Many empirical formulæ have been given, most of which are entirely wrong. One, however, recently enunciated by Fröhlich, gives a relation which agrees very closely with observed values. This formula is $m = \frac{i}{a + b i}$, where m is the magnetic moment of the core, i the current and a and b constants depending upon the geometrical form of the magnet, and the nature and previous history of the iron core. Fröhlich obtained this relation by experimenting with a series dynamo. It is purely empirical, but since it agrees so well with the facts as to give values for the magnetism of the core agreeing almost within experimental error with those observed, there is great probability of some law being at its base. And this law, Prof. Thompson believes, to be one that was stated years ago by Lamont:—"The magnetic permeability varies with the quantity of magnetism the iron is capable of taking up." This may be expressed by the formula

$$\frac{d\,m}{d\,i} = k\,(\mathrm{M} - m).$$

Integrating which and expanding e^{-ki} in powers of i.

$$m = \mathrm{M}\,k\,i\left\{1 - \frac{k\,i}{2} + \frac{k^2\,i^2}{6} - \ldots\right\}.$$

Expanding Fröhlich's equation in powers of i we get

$$m = \frac{i}{a}\left\{1 - \frac{b\,i}{a} + \frac{b^2\,i^2}{a^2} - \ldots\ldots\right\}.$$

If $k\,i$ is not great these expressions will coincide in form very closely, and the results lead Prof. Thompson to accept Lamont's expression as being that of a real physical law.

Prof. PERRY suggested that Lamont's law gave good results from its being an approximation to Weber's theory of induced magnetism, but

Prof. THOMPSON maintained that it represented observed facts better than that theory, which, as developed by Maxwell, shows a decided discontinuity in the process of magnetisation not actually observed.

Prof. FLEMING remarked upon the similarity of Fröhlich's expression to that for the current through a voltameter; the part $a + b\,i$ corresponding to the apparent resistance which may be considered in this case as the resistance to magnetisation of the core-air circuit, and which, like that of the voltameter, varies with the current.

NEW PATENTS—1885.

13279. "Insulators for telegraph wires and the like." W. P. THOMPSON. (Communicated by E. A. Müller.) Dated November 3. (*Complete.*)

13319. "Dynamo machines." M. IMMISCH. Dated November 4.

13333. "Incandescent lamp holder." J. LEE. Dated November 4.

13343. "Constant current dynamo-electric machine." S. P. THOMPSON. Dated November 4.

13362. "Mechanical telephone." L. N. LOEB. (Communicated by C. Loeb.) Dated November 4.

13363. "Mechanical telephone." L. N. LOEB. (Communicated by C. Loeb.) Dated November 4.

13416. "Automatic switches." L. CLERC. Dated November 5.

13422. "Electric generator with automatic feed." W. A. BARLOW. (Communicated by M. Sappey.) Dated November 5.

13451. "Neutralising the residual magnetism in electro-magnets." E. G. COLTON. (Communicated by F. and O. Haenichen and O. Seebass.) Dated November 6. (*Complete.*)

13453. "Electric clocks." E. G. COLTON. (Communicated by F. and O. Haenichen and O. Seebass.) Dated November 6. (*Complete.*)

13478. "Electrical switch boards, or apparatus for connecting sources of electricity, such as dynamos, with electrical circuits." R. A. SCOTT, W. T. GOOLDEN, A. P. TROTTER. Dated November 6.

13543. "Application or employment of the electric search-light to a gun or cannon." J. K. ROGERS. Dated November 7.

13551. "Transporting cash, memoranda or goods from one part to another part of a shop or warehouse, or for similar purposes." W. R. LAKE. (Communicated by the Kenney Electrical Cash Carrier Company.) Dated November 7.

13571. "Mercurial air pumps for exhausting incandescent or glow lamps." W. MAXWELL, T. V. HUGHES. Dated November 9.

13575. "Conveying articulate speech by electricity, and apparatus for that purpose. H. J. ALLISON. (Communicated by A. M. A. Beale.) Dated November 9.

13607. "Telephonic receivers or transmitters." C. A. GISBORNE. (Communicated by F. N. Gisborne and D. H. Keeley.) Dated November 9.

13610. "Connecting and disconnecting electric circuits for telephonic communication." F. B. O. HAWES. Dated November 9.

13612. "Arc lamp." E. A. ASHCROFT. Dated November 9.

13639. "Carbon filaments for incandescent lamps." W. MAXWELL. Dated November 10.

13668. "Telegraphic instruments." G. W. STEUART. Dated November 10. (*Complete.*)

13694. "Voltaic batteries." J. P. REES, T. D. C. PARKER. Dated November 10.

13696. "Telephonic systems." J. STEPHEN. Dated November 10.

13697. "Secondary batteries, or electrical accumulators." J. Y. JOHNSON. (Communicated by S. Farbaky and S. Schenck.) Dated November 10.

13704. "Electric meters." G. PITT. (Communicated by J. Caudery.) Dated November 10.

13721. "Automatic signalling electric press button." B. F. HOWARD, T. L. HAIG. Dated November 11.

13744. "Regulating or intercepting the current from dynamo-electric machines." E. J. HOUGHTON. Dated November 11.

13810. "Electric lamps." V. KLEIN, F. SPURNY. Dated November 12.

13828. "Magneto-telephonic instruments." S. P. THOMPSON, P. JOLIN. Dated November 12.

13829. "Driving gear for electric driven tramcars." B. M. DRAKE, J. M. GORHAM. Dated November 12.

13873. "Regulating and controlling electric currents." A. GRUNDY. Dated November 13.

13902. "Electrical switch." G. MARRIS. Dated November 14.

13951. "Dynamo-electric machines." G. TOLMAN, H. DENTON. Dated November 16.

13974. "Electric signalling or call apparatus." C. E. ZIMDARS. Dated November 16.

13998. "Electrical incubators." H. J. ALLISON. (Communicated by C. Bassini and A. Heyden.) Dated November 17. (*Complete.*)

14037. "Thermo-electric batteries." A. BURJORJI. Dated November 17.

14076. "Incandescent electric lamp holder." E. W. J. HENNAH. Dated November 17.

14078. "Electric lighting." W. EMMOTT, W. ACKROYD. Dated November 17.

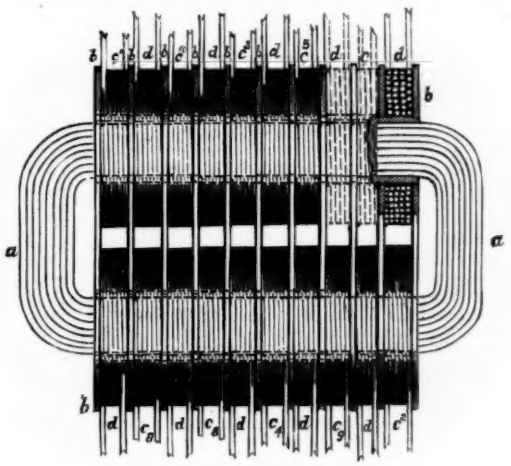
ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

13096. "Improved method and means of stopping runaway or kicking horses by electric action." W. K. BROCK. Dated October 2. 2d. A current of electricity is passed through the horse's spine from the mouth to the tail by suitably arranged conducting wires, forming part of the harness. The electricity is either stored or generated at the time required for use, and gradually applied till increasing muscular spasm compels the animal to stop.

13392. "An improved electric arc lamp." A. W. RICHARDSON. Dated October 10. 6d. A toothed wheel of the clockwork gears into a rack forming the upper carbon holder and is raised to form the arc by means of a main magnet the core of which is wound round with a coarse wire. The armature is fixed in two side levers, the other end of which carries the clockwork, and when the armature is attracted by the magnet it raises the rack and clockwork and brings a brake wheel in the clockwork up into contact with a brake. This brake is fixed on an armature which is raised by an inverted "shunt" magnet. The brake wheel has a reciprocating motion like the balance wheel of a watch and is driven by a verge escapement from the crown wheel of the clockwork. When the tension spring is adjusted to the arc resistance, the brake is raised by the "shunt" magnet every few seconds and thus lowers the upper carbon tooth by tooth which maintains the arc at all times the same size.

13525. "Improvements in and relating to electric burglar alarms." H. H. LAKE. (Communicated from abroad by H. C. Roome, of America.) Dated Oct. 13. 1s. Involves the combination in an electric burglar alarm comprising an internal circuit and an external circuit, of a galvanometer or differential relay magnet located in the office having one coil included in the internal circuit, the other coil included in the external circuit, and each being adapted to affect the galvanometer or differential relay magnet differently, and such resistances in the internal circuit and the external circuit that the action of an electric current passing through the two circuits will hold the galvanometer or differential relay magnet normally in equilibrium. Any variation of resistance in the external circuit occasioned by the opening of the door or window will affect the operation of means whereby an alarm will be given at the office. The invention also consists partly in the combination, in an electric burglar alarm comprising an internal circuit and an external circuit, of mechanism at a guarded structure whereby a number of different resistances may be successively thrown into the external circuit by means of increasing at the office the electric current passing through the circuits, mechanism at the office whereby, on the increasing of the electric current, a number of corresponding resistances will be thrown into the internal circuit and means located at the office and serving to give an alarm there in case the external circuit is tampered with in an attempt to gain access to the guarded structure.

14233. "Improvements in the construction and application of induction coils." J. HOPKINSON and E. HOPKINSON. Dated October 28. 6d. The fig. shows in side elevation and partial section a neutral induction coil or secondary generator constructed according to the invention. *a* is a core of hoop iron, or of iron wire magnetically continuous, but having its sections separated from each other by insulating material to prevent waste of energy by currents circulating in the iron. *b* is a framework of insulating



material separating the several coils of wire from each other, and from the core. It is preferred to make the frame of non-combustible material, such as slate (but this is not essential) as the mere reversal of the magnetism of the iron heats it when the number of reversals per second is considerable; it is also preferable to leave a space between the core, *a*, and the frame, *b*, to admit of the circulation of air to cool the core. Upon the frame, *b*, are wound a series of coils of insulated copper wire, *c*, to form the primary circuit, and alternately with these a series of

similar coils, *d*, are wound to form the secondary circuit. The coils, *c*, may be coupled in any way, but as a rule they will be coupled in series. The coils, *d*, also may be coupled either parallel or in series, or otherwise, according to the particular purpose they have to serve. The inventors place the secondary coils between the primary coils alternately, in order to avoid the production of consequent poles in the core; but they consider it better not to place a secondary conductor in close juxtaposition to each primary conductor, as is now frequently done, as the electrostatic induction between the primary circuit and the secondary circuit may cause a high difference of potential between the secondary circuit and the earth.

14693. "Improvements in apparatus for automatic registration of numerals by electricity, applicable to output of coal mines or other like uses. C. FORD. Dated November 7. 6d. Consists of an electrical counter operated by a press button.

14829. "Improvements in dynamo-electric machines." J. H. GREENHILL. Dated November 11. 6d. In a modification of armatures known as the "Burgin" type, the inventor makes the rings of thin sheet iron, hexagonal in shape, but instead of coiling one length of wire on each of the spaces between the projecting corners of the ring, he winds two lengths and brings the ends out to the commutator plates, by this means getting a sufficient number of commutator plates with half the number of iron rings, but of more than double width, thus getting a higher efficiency.

14953. "Improvements in electrical apparatus for communication between passengers, guards, and drivers of railway trains." J. RADCLIFFE. Dated November 13. 6d. The inventor employs a combined commutator and indicating apparatus consisting of a drop disc attached to either or both ends of a rod passing through or across each of the compartments of the carriages forming railway trains, the said rod being free to revolve through a portion of a circle, and carrying at its centre, or other convenient spot, a cam which engages in a detent attached to a knob inside the compartment, which knob may be constructed either to pull or push, but which the inventor prefers should be made to pull. The cam being released, by the knob being pulled or pushed, the rod revolves and the discs fall in front of glazed openings on the outside of the particular compartment, on one or both sides of the train; at the same time a point attached to the disc or other part comes in contact with a spring attached to the framework, and forms an electrical connection between two otherwise insulated wires, permanently fixed to the carriages, and attached at the ends of each carriage to couplings hereinafter described, by means of flexible cables. The inventor maintains the continuity of electrical connection throughout the length of the train by means of an improved form of coupling (placed between adjoining carriages) composed of two pieces or halves, each half consisting of two springs attached to an insulating block, each spring carrying a wedge-shaped piece of ebonite, or other insulating substance, attached to one side of which insulating substance is a plate of metal, connected to the end of one of the insulated wires in the flexible cable, previously mentioned, and arranged in such a manner that when the two halves of the coupling are joined together the two metal plates on the one half are separated from each other, and each placed in contact with the corresponding metal plate on the other half, and when the two halves of the coupling are separated, the respective metal plates on each separate half come in contact with each other, thus completing an electrical circuit on each side of the point of separation.

15111. "Governors for regulating the speed of motors driven by electricity." FLEEMING JENKIN. Dated November 17. 6d. The inventor arranges a centrifugal governor, so that at a given speed, say 500 revolutions per minute, the weights fly out through a considerable range, until directed in a new position by a stop. They do not fall back to their first position until another lower speed of, say, 450 revolutions per minute, is reached; but remain unchanged in the second position, while the speed falls from 500 to 451 revolutions per minute. This result is obtained by using a spring to restrain the diverging weights of such length, and so placed that the force with which it restrains the weights increases less rapidly than the centrifugal force increases as the weights diverge. At the two critical speeds the weights are in unstable equilibrium. He connects the make and break arrangement with the diverging weights by a system of links, and it is easy to see that the large and rapid divergence of the weights at the critical speed will open the make and break suddenly to a great distance, a few sudden breaks occurring three or four times a minute are substituted for innumerable small sparks, as would occur in an ordinary centrifugal governor when the critical speed is reached.

CORRESPONDENCE.

The Last Telephone Suit.

Can you or any of your readers inform me whether Mr. Justice North has yet given his full decision, with his reasons for the same, in the case of "The United Telephone Company *v.* Bassano," and if, as I understand is the case, he has not yet done so, whether there is any way of knowing when the said full decision is likely to be published.

Taking into consideration the fact that the case was heard some time before the long vacation, it seems to be about time that the full decision were published.

The apparent delay is no doubt very convenient for the United Telephone Company, but it is inflicting serious injury on the public at large.

"Telephonist."

[Mr. Justice North's full decision has not yet been given. When he does determine to make known his reasons for the decision he announced before the vacation, the information will probably be given in the usual way in the Law Notices, which are published in the morning papers.—EDS. ELEC. REV.]

"Primary" and "Secondary" Batteries.

In answer to Mr. Kingsland's very pertinent question, I am inclined to adopt, with a little alteration and simplification, the definition which he gives as the generally accepted one. A strict definition has yet to be agreed upon; and it is possible that the practical meaning of the term "secondary battery" may differ somewhat from its theoretical definition. With the former in view, rather than the latter, I should say that "a secondary battery is one in which the elements, after being discharged, may be restored to their original active condition by the action of a current of electricity, without any manipulation of either of the elements, any addition to the electrolyte, or the substitution of one electrolyte for another." I should certainly not accept as a secondary battery any voltaic arrangement that did not fulfil all these conditions. Thus, if it were requisite—in order to ensure certainty of action—that the spongy lead element of a battery should be re-made, or should be treated with (say) an alkaline solution, each time the battery was discharged, the apparatus would not, at least in the practical sense, constitute a secondary battery. A Leclanché battery is not a secondary battery, because the ammonia which escapes from it during discharge would have to be replaced in the process of charging, before the battery could be restored to its *original* active condition. A Daniell battery is not a secondary battery, because the operation of the law that "the electro-positive component of the electrolyte, or, where there are several such components, the least electro-positive amongst them (in this case copper) travels with the current," prevents the battery from being reconstituted in its original condition. Merely removing the elements of a battery from one receptacle to another, prior to charging or discharging, does not invalidate its claim to be considered a secondary battery, provided the charge and discharge can be effected without such removal, and without the substitution of a different electrolyte.

Thus much, for the present, as to what constitutes a secondary battery. I take it that, practically, a battery that does not come up to the definition of a secondary battery, is a "primary battery." To term it simply a "voltaic battery," would not be sufficiently distinctive, since a secondary battery also is a voltaic battery. A battery of which the elements, or the active portions of them, are obtained electrolytically is not necessarily a secondary battery.

In reference to Mr. Kingsland's concluding observations, I have to point out that there are several forms of lead battery of my invention, some of which are "primary," and others "secondary." The one to which special attention has recently been directed in these columns belongs to the latter class. I term *lithanode*—for the sake of distinction—the very dense and highly conductive form of hydrated peroxide of lead constituting the negative element of the battery in question.

Desmond G. Fitz-Gerald.

6, Akerman Road, Brixton.